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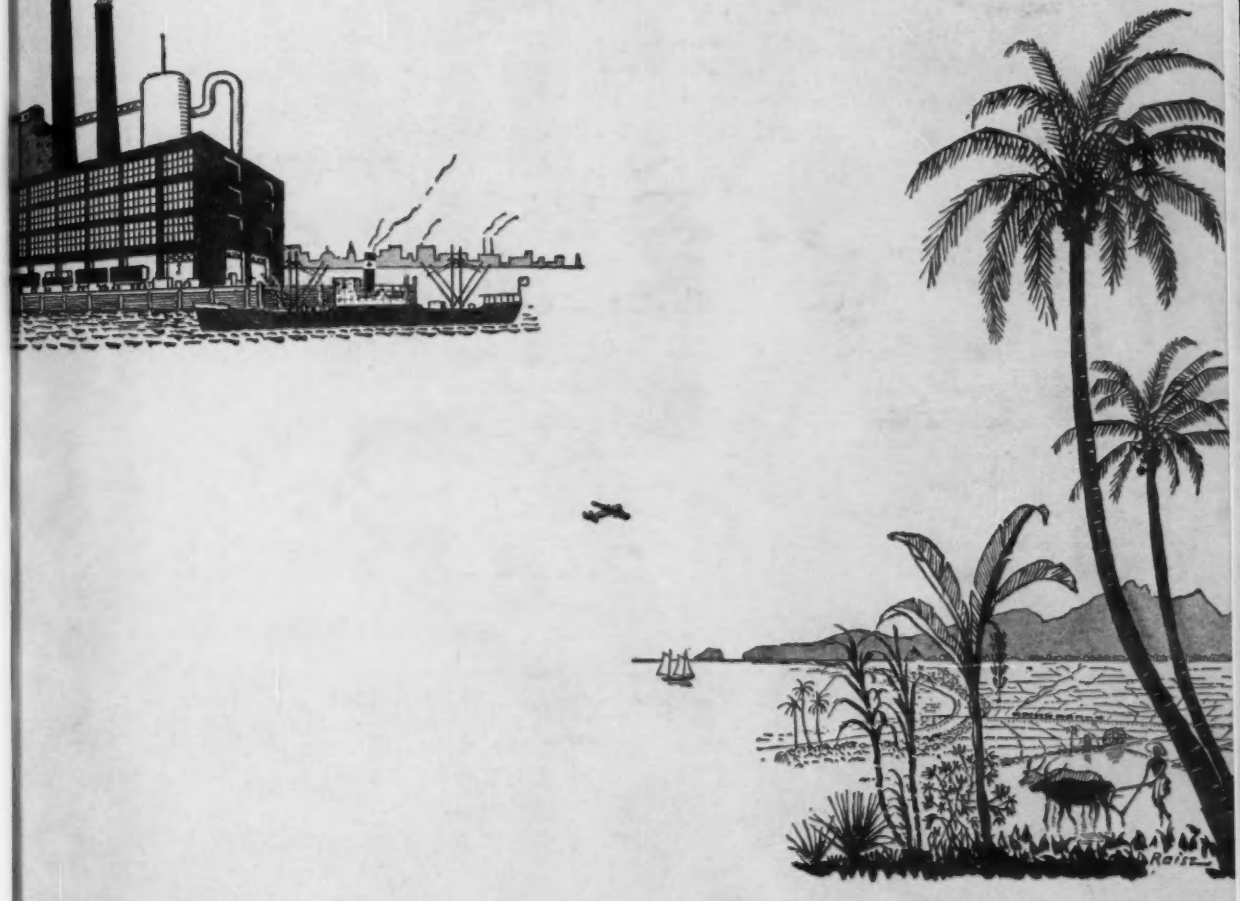

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ECONOMIC GEOGRAPHY

CONTENTS FOR JULY, 1952

The Tobacco Industry of Southern Rhodesia . . . . . *Peter Scott* 189
Erosion of Farmery Sites in the Nashville Basin of Middle Tennessee *J. R. Whitaker* 207
The Development of Industry in Egypt . . . . . *Alan B. Mountjoy* 212
The Physical Basis of Agriculture in British Columbia . . . . *Donald Kerr* 229
A Technique for Constructing a Population and Urban Land Use Map *William Applebaum* 240
Boston's Chinatown . . . . . *Rhoads Murphey* 244
Penn Township—An Example of Local Governmental Control of Strip Mining in Pennsylvania . . . . . *E. Willard Miller* 256
Niagara Falls Power Redevelopment . . . . . *Wallace McIntyre* 261

BOOK REVIEWS

Josué de Castro: The Geography of Hunger . . . . . *Stephen B. Jones* 274
Ronald L. Mighell and John D. Black: Interregional Competition in Agriculture with Special Reference to Dairy Farming in the Lake States and New England . . . . . *Loyal Durand, Jr.* 275
Edwin S. Munger: Relational Patterns of Kampala Uganda *Derwent Whittlesey* 276
N. T. Mirov: Geography of Russia . . . . . *William Applebaum* 277
John A. Ryan: The Production and Marketing of Flax in Texas *John C. Weaver* 278
John W. Alexander: Oshkosh, Wisconsin—An Economic Base Study *Howard J. Nelson* 279
Ten Rivers in America's Future: The Report of the President's Water Resources Policy Commission, Volume 2 . . . . . *Victor Roterus* 280
Brigadier Sir Clinton Lewis, O.B.E., and Colonel J. D. Campbell, D.S.O., Edit.: The American Oxford Atlas . . . . . *Guy H. Burnham* 281

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ECONOMIC GEOGRAPHY

VOL. 28 JULY, 1952 NO. 3

THE TOBACCO INDUSTRY OF SOUTHERN RHODESIA

Peter Scott

Mr. Scott, until recently lecturer in geography at the University of Capetown, has been appointed senior lecturer in charge of geography at the University of Tasmania, Hobart. He is the author of a number of articles dealing with the geography of southern Africa.

SOUTHERN Rhodesia, which until World War II was a relatively insignificant producer of flue-cured tobacco, now ranks among the world's leading tobacco exporters. Before the war, although a vast potential of suitable farmland and cheap native labor gave scope for expansion, the tobacco industry was handicapped by high transportation costs. Of late, however, the dollar shortage of the sterling area, together with sterling devaluation, has given a marked fillip to the industry. Since 1945, when tobacco surpassed gold as the premier export of Southern Rhodesia, production has more than doubled, and in 1950, despite an increase in base-metal output, tobacco accounted for more than two-fifths of the Colony's exports. As a result, the tobacco industry, which in many aspects contrasts sharply with that of the United States, has become the mainstay of the country's economy, and the distribution of tobacco cultivation, which is closely controlled by physical and economic factors and reveals marked regional characteristics, has undergone significant changes.

DISTRIBUTION OF TOBACCO TYPES

In 1950, of the total production of 107,018,000 pounds, bright flue-cured tobacco suitable for cigarette manufacture furnished no less than 105,492,000 pounds, or 98.6 per cent. Its cultivation was confined to land above 3000 feet, which alone favors European settlement, and to areas receiving at least 28 inches of rain a year (Fig. 1). Within these limits, the main tobacco region—hereafter in this article called the Tobacco Belt—broadly corresponds to land above 4000 feet, known locally as the high veld, and to areas with a rainfall of at least 32 inches a year (Figs. 2 and 3). At the same time, cultivation is largely excluded from the eastern mountains and the highlands east of Salisbury, where the rainfall is excessive and frost may occur. Consequently, tobacco is grown mainly in areas between 4000 and 5000 feet in elevation, where the rainfall is between 32 and 36 inches a year. Such areas make up about one-sixth of the Colony.

Within these areas, the distributional pattern of tobacco cultivation is determined primarily by the extent of European-owned land and its accessibility to railroad. Thus the acreage under tobacco in the Charter and Gutu districts, both located far from the main Salisbury line, is comparatively insignificant, even though physical conditions favor cultivation and tobacco is in fact the principal crop grown on almost half

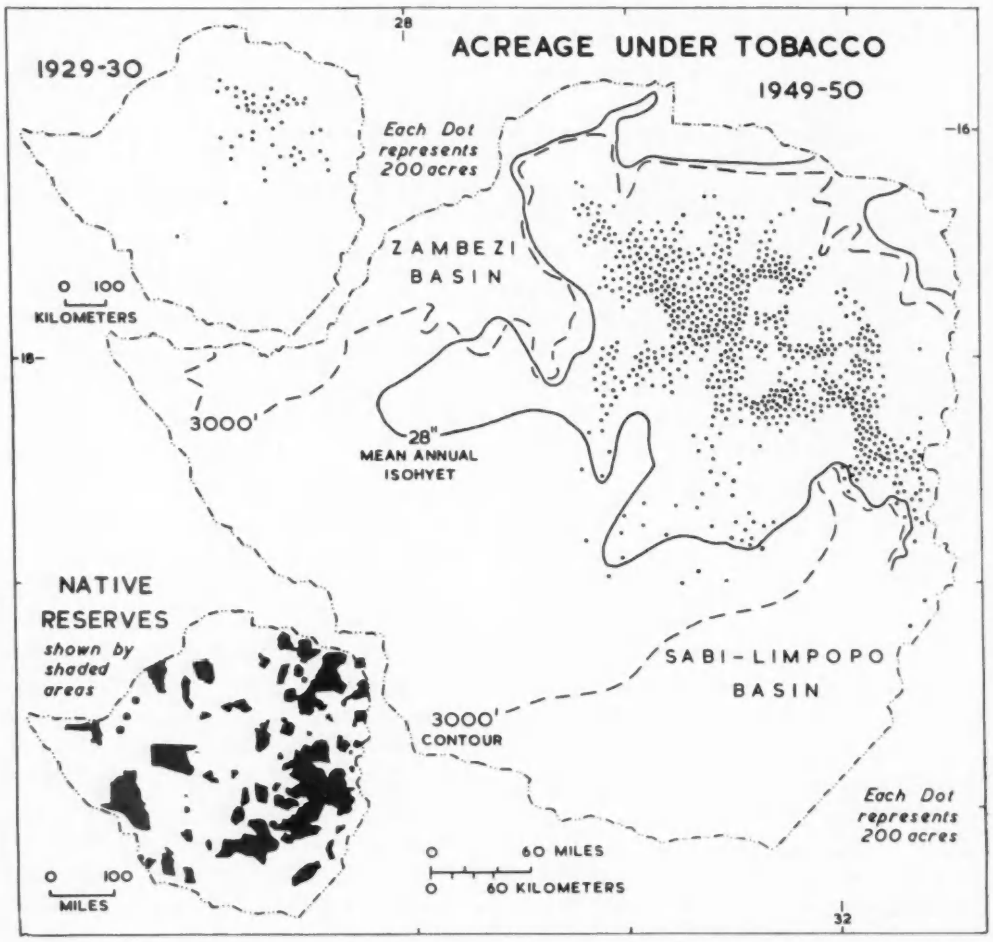


FIG. 1 Tobacco cultivation in Southern Rhodesia is confined to European lands above 3000 feet, which receive a rainfall of at least 28 inches a year. Such areas occur only in the northeast.

the European farms (Fig. 4). On the other hand, where the railroad descends to the middle veld (4000 to 2000 feet) and rainfall is adequate, tobacco production is important. Thus the Tobacco Belt, which excludes the high veld around Enkeldoorn and Gutu, includes the middle veld around Gatooma and Bindura and northwest of Sinoia and Umtali.

Although flue-cured tobacco is essentially a high-veld crop, fire-cured tobacco, which in 1950 yielded 1,241,000 pounds, is essentially a crop of the midlands. Most of the production comes from land between 3000 and 3500 feet, though cultivation also takes place at slightly higher altitudes. The crop is confined to the Mazoe district. Other Virginia type tobacco—in Southern Rhodesia, the term "Virginia" is applied to all tobacco types originating from the United States—is mainly cigar leaf; in 1950, it furnished only 8570 pounds. Wrapper leaf requires a heavier rainfall than either flue-cured or fire-cured tobacco, and is therefore grown in the eastern mountains, principally in the Chipinga district. On the other hand, Turkish tobacco—the term "Turkish" denotes all varieties originating from the Middle East—requires less moisture

than flue-cured tobacco, but, even so, its cultivation is mainly confined to the Tobacco Belt. In 1950, production amounted to 276,000 pounds.

CHANGES IN DISTRIBUTION, 1895–1930

Only in the present century has tobacco been a crop of the high veld. Before the arrival of white settlers, the principal areas of cultivation were the Wankie and Sebungwe districts, where for long the natives had grown tobacco for their own use. In 1894 to 1895 a European farmer in the Umtali district experimented with tobacco planting, followed in 1898 to 1899 by farmers in Nyamandhlovu and in 1900 to 1901 by others in Insiza. So successful were these early experiments in the midlands that in 1904 George M. Odlum of the Department of Agriculture was sent to the United States to study tobacco culture; his report did much to establish tobacco growing on a sound basis. Later, in 1907, as a result of a visit by Odlum to Greece and Turkey, 14 Greek growers arrived in the Colony to found the Turkish tobacco industry.

The introduction of tobacco auctions at Salisbury in 1910, together with the provision of a warehouse under the management of an experienced Virginian warehouseman, gave a market advantage to growers in the north-

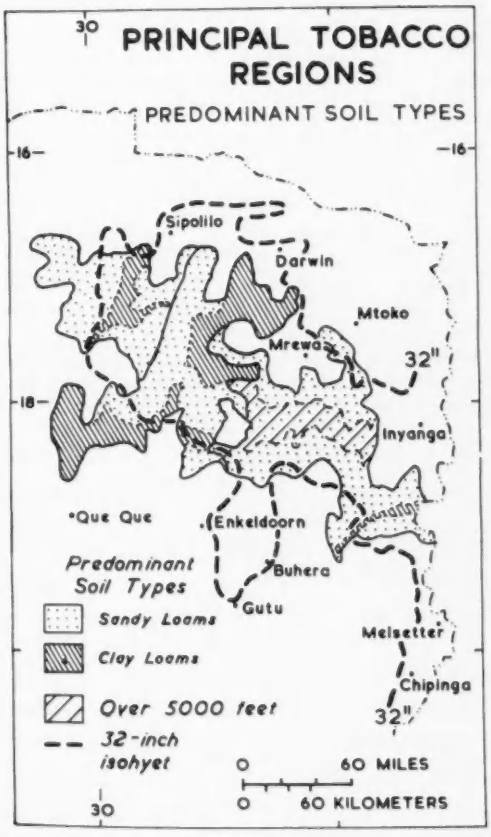


FIG. 2 (left). The Tobacco Belt corresponds broadly to areas within easy access to railroad and receiving a rainfall of at least 32 inches a year. Within the Belt, which may be divided into three distinct regions, flue-cured tobacco is grown mainly on sandy loams and fire-cured tobacco mainly on clay loams.

FIG. 3 (right). The Tobacco Belt includes much of the northeastern high veld (land above 4000 feet), where half the European population of the Colony is concentrated.

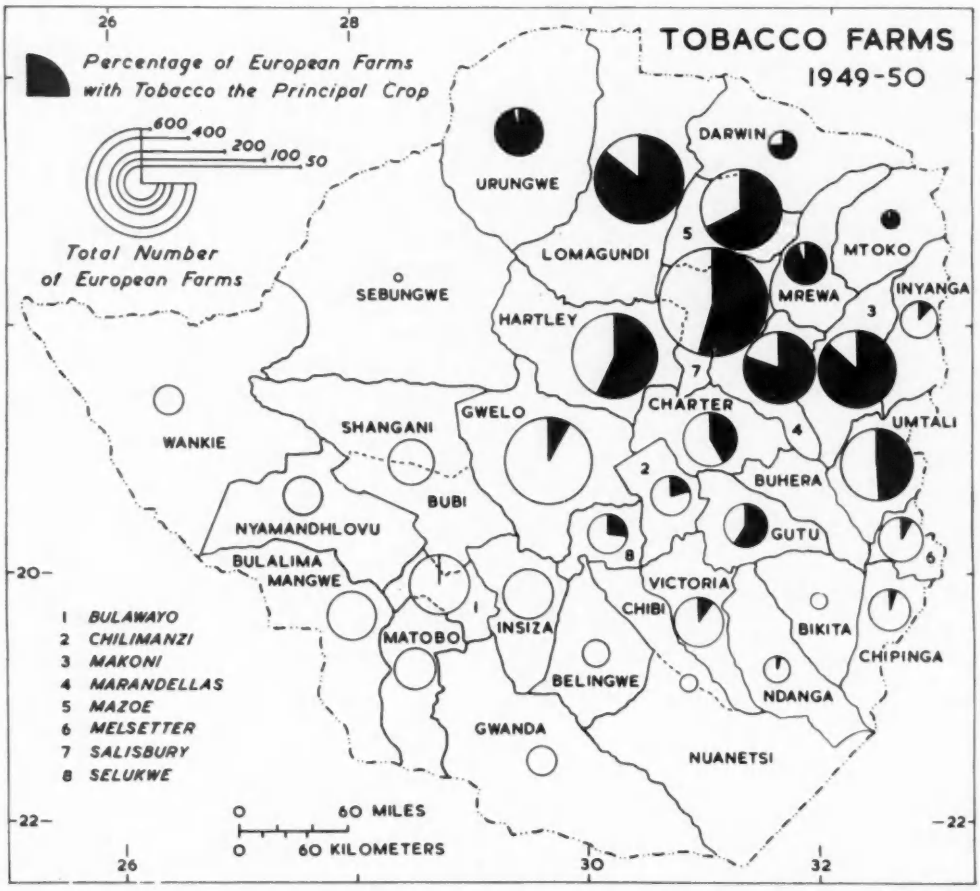


FIG. 4. Tobacco is the principal crop on more than two-fifths of all European farms in Southern Rhodesia. Even in districts south of Salisbury, where tobacco occupies a comparatively insignificant acreage (see Fig. 1), it remains the chief source of income on many—in Gutu, most—European farms.

eastern high veld, where climatic conditions had already proved themselves more suited to tobacco growing than in the midlands. Consequently, as the output rose from 100,000 pounds in 1910, the first year of commercial production, to 3,062,000 pounds in 1913, cultivation became concentrated within the Tobacco Belt, even though the crop distribution showed marked regional differences from the present pattern. From 1910 to 1913 almost the entire output was marketed in South Africa. In 1914 a large consignment was sent to Britain, but the prices realized were unremunerative. The failure to develop a market in Britain coincided with a slump in the South African market, so that the auction sales broke down and many farmers became bankrupt. Accordingly, production fell to 426,000 pounds in 1915.

A co-operative society was then formed to promote tobacco cultivation and to undertake warehousing and marketing, but it was not until 1921 that output again reached the 1913 peak. For the next five years, though production fluctuated with variations in climatic conditions, in the incidence of plant disease, in the fertilizer supply, and in market demand, the 1921 level was more or less maintained. The six chief tobacco districts together ac-

counted for more than 90 per cent of the total acreage and nearly 95 per cent of the total output (Table I). The principal market was South Africa, and only small amounts were exported overseas or manufactured at home. In 1923 an export company assumed the functions of the co-operative society.

After 1925 an increase in the rebate on import duties allowed under the Imperial Preference Scheme, combined with an influx of new settlers following the Wembly Exhibition, brought about a sudden expansion. From 5,660,000 pounds in 1926 production multiplied to 24,889,000 pounds in 1928. Within the Tobacco Belt, expansion was greatest in the northwest and least in the southeast, but in marginal areas remote from the Belt, the rate of expansion was even greater. Thus such districts as Sebungwe, Nyamandhlovu, and Bulalima Mangwe, which no longer produce tobacco, furnished significant outputs at the height of the boom. By 1929, however, overproduction throughout the British Empire had precipitated a slump, and in 1930, when the marginal districts had almost ceased to grow tobacco, overall production was only 5,844,000 pounds. Although the acreage had fallen almost to the 1924–1925 figure, Mazoe and Lomagundi, which in the boom had ousted Marandellas from pride of place, remained the centers of production. During the late twenties, Turkish tobacco, grown mainly in the Bulawayo and Lomagundi districts, and fire-cured tobacco, first planted in Mazoe in 1924, had occupied small but comparatively constant acreages.

CHANGES IN DISTRIBUTION, 1930–1950

The year 1930 marks the close of the speculative period of tobacco production. After a recovery in the early thirties, prompted in part by Britain's guarantee at the Ottawa Conference in 1932 of continued Imperial Preference, output became more or less stabilized at about 24 million pounds annually until World War II (Fig. 5). Underlying this apparent stability was a significant redistribution of acreage; it resulted both from a closer adjustment of tobacco cultivation to the physical environment and from a fuller appreciation of locational advantages with respect to railroad facilities and proximity to market. Thus in Mazoe, where soils are generally too heavy for flue-cured tobacco, the acreage remained more or less constant after 1933. In Lomagundi, on the other hand, where soils are generally lighter and more suitable, expansion was continuous throughout the thirties. Moreover, the concentration of production in the northwestern districts of the Tobacco Belt—a marked feature of the twenties—became even more marked during the thirties (Fig. 7). Elsewhere, development was characterized by a lower expansion rate in the southeast, where soils are ideal for flue-cured leaf but transportation facilities are less favorable, and a relative decline in the southwest, where soils are again too heavy. Around Hartley, as well as in marginal districts outside the Belt, the tobacco acreage remained far below the 1928 peak, but in Umtali, hitherto notable only for a small output of air-cured tobacco, and more especially in Makoni and Mrewa, tobacco was of increasing importance. Unfortunately, fire-cured leaf, which requires a heavy soil, was unable to compete with native-grown exports from neighboring territories. Turkish tobacco, which continued to occupy a small but constant acreage, was confined to Lomagundi.

Development during the forties may be divided into two distinct phases: the war years, when acreage increased fairly steadily but owing to climatic conditions and fertilizer shortages production fluc-

tuated between 34 and 52 million pounds; and the post-war years, which have witnessed an unparalleled expansion both in acreage and output. In 1946, when production amounted to 47,219,000 pounds, the principal districts, except Umtali, ranked the same as in the thirties, but in 1950, when production had reached 107,018,000 pounds, Salisbury with its superior marketing facilities and Makoni with its superior soils had both outstripped Mazoe.

Nevertheless, both the war and post-war phases exhibit similar regional trends. In general, outlying districts, invariably remote from railroad and warehouse and often characterized by unfavorable physical conditions, underwent the greatest *relative* expansion, followed by the southwestern district of the Tobacco Belt, the southeastern districts, and the northwestern. At the same time, the greatest *absolute* expansion, in marked contrast to the twenties and thirties alike, occurred in the southeast, notably in Marandellas and Makoni (Fig. 7).

Meanwhile, Turkish tobacco spread throughout the Tobacco Belt. Although Lomagundi remained the dominant producer, Mazoe, Salisbury, Makoni, Mrewa, and Hartley, to give the other main producers in order, all came to have significant acreages. The crop area rose from 1987 acres in 1939–40 to 10,632 acres in 1945–46, but thereafter, owing to the higher prices ruling for flue-cured leaf, which in any case gives greater yields per acre, the area fell to only 775 acres in 1949–50. Cultivation has, however, remained widespread. In contrast, the production of fire-cured tobacco in Mazoe has remained constant.

TABLE I

TOBACCO ACREAGE IN SOUTHERN RHODESIA BY PRINCIPAL DISTRICTS AT FIVE-YEAR INTERVALS, 1925–1950

	1924–25	*1929–30*	*1934–35*	*1939–40*	*1944–45*	*1949–50*
Urungwe[a]	.....	.....	.....	.....	.....	5,457
Lomagundi	982	2,645	12,985	17,064	18,234	26,290
Mazoe	1,655	2,849	11,672	12,107	12,858	19,160
Salisbury	1,308	821	4,892	9,943	11,684	22,394
Hartley	1,236	1,124	1,819	2,923	3,611	14,228
Mrewa	350	493	1,639	1,938	1,981	6,648
Marandellas	1,781	1,148	2,890	5,535	6,578	16,309
Makoni	718	513	3,509	6,892	9,278	20,544
Umtali[b]	.....	.....	588	2,209	4,823	10,456
Other districts	411	875	1,012	1,346	1,990	11,231
Totals	8,441	10,468	41,006	59,957	71,047	152,717

Sources: *Official Year Book of the Colony of Southern Rhodesia*, No. 1, 1924, and No. 2, 1930; *Statistical Year Book of Southern Rhodesia*, 1938 and 1947; and *Economic and Statistical Bulletin of Southern Rhodesia*, Vols. 15–18, 1948–1951

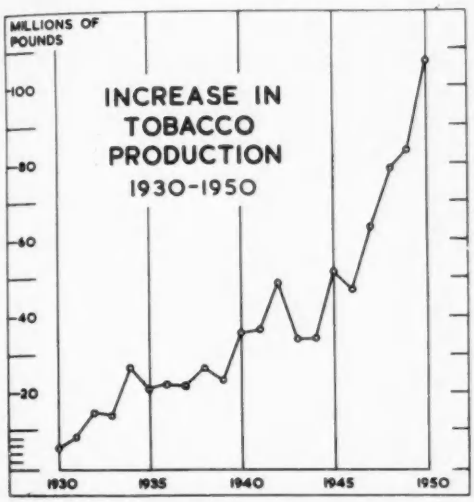
[a] Prior to 1848–49 Urungwe was included in Lomagundi.

[b] Prior to 1930–31 Umtali was included in "Other districts."

TOBACCO FARMS AND THE FARMING SYSTEM

The rapid post-war development of the tobacco industry, together with its growing relative importance in the rapidly-expanding agricultural economy, is borne out by the proportion of European holdings classed as tobacco farms (Fig. 4). The number of tobacco farms in Southern Rhodesia has risen from 800, out of a total of 3400 European farms in 1945, to 2200, out of a total of 5000 in 1950, and the proportion of tobacco farms to total European farms in the Tobacco Belt has increased from one-half to three-quarters.

The typical tobacco farm covers about 2500 acres, but most farms, if not all, are underdeveloped. Summer crops rarely occupy more than 250 acres, and winter crops, though sometimes extending to 15 acres, are frequently absent. On some farms, on perhaps as many as one-quarter of the total, tobacco occupies at least 100 acres, and in one instance as much as 1000, but the average amounts to only 70 acres. Even so, the tobacco acreage per farm, which furnishes about three-quarters of the farm income, is substantially greater than in the United States. On many farms, considerable tracts of woodland are set aside for the provision of firewood for the curing barns. Moreover, some farmers give grazing or cropping rights to married employees.



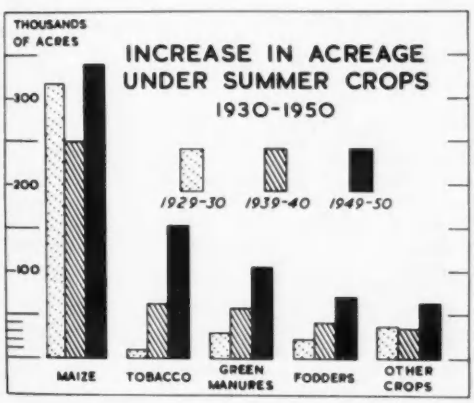


FIG. 5. From only 5,844,000 pounds in 1929–30, tobacco production in Southern Rhodesia has multiplied to 107,018,000 pounds in 1949–50.

FIG. 6. Whereas in 1929–30 maize occupied 76 per cent of the total acreage under summer crops and tobacco only 3 per cent, in 1949–50 they occupied 46 and 20 per cent respectively. Maize has, in fact, lost appreciably more ground as a cash crop than these figures indicate, because an increasing proportion of the maize output is consumed on the producing farms by native employees. This applies especially to tobacco farms, where maize is usually grown in rotation with tobacco, a green manure, and a fodder crop.

On many long-established tobacco farms, soil fertility has been seriously impaired by the root-knot nematode (*Heterodera marioni*, Cornu), commonly known as tobacco eel-worm. Infestation has resulted largely from the application of stream water to seed beds, and from the growing of nematode hosts, such as cotton (though a local strain 9L34 is immune), beans, cowpeas, potatoes, and sunflowers, in rotation with tobacco. In recent years, the alarming spread of nematode has led increasingly to the use of water from boreholes and wells and to the adoption of crop rotations in which tobacco is grown only with resistant crops.

Crop rotations, necessary in any case to maintain the yield and quality of tobacco leaf, vary greatly from farm to farm. Some farms practise a three-year rotation, though this is undoubtedly too short to allow the land to regain condition after tobacco; others practise a seven-year rotation, apparently the most suitable for flue-cured tobacco on characteristic sandy loams. The rotation invariably includes maize; in areas where clay loams predominate, maize is in fact an important cash crop, but elsewhere it is grown primarily as food for native employees. Maize usually follows tobacco in the rotation, since its yield is then greater than if it follows most other non-leguminous crops. Legumes, though often included as a green manure, cannot

immediately precede tobacco, because excessive nitrogen accumulation adversely affects the quality of tobacco leaf. On some farms, a small grain or grass crop, invaluable for building up the humus content of the soil, has of late been substituted for legumes or added to the rotation (Fig. 6). Where land suitable for tobacco is abundant and climatic conditions favor the rapid regeneration of the veld, some farmers plant two successive tobacco crops followed by three to ten years of grass fallow. However, the best rotation would seem to be tobacco, tobacco, maize, a green manure, and three years of grass.

SOILS AND FERTILIZERS

Except for fire-cured Virginia, the bulk of each type of Rhodesian tobacco is grown in areas of so-called "sand veld," which consists of sandy loams derived from granite and sandstone. In sandstone areas, which occupy comparatively limited tracts of the Tobacco Belt, the pink surface soil is usually deep, but in granite areas, which predominate not only in the Tobacco Belt but throughout Southeastern Rhodesia,

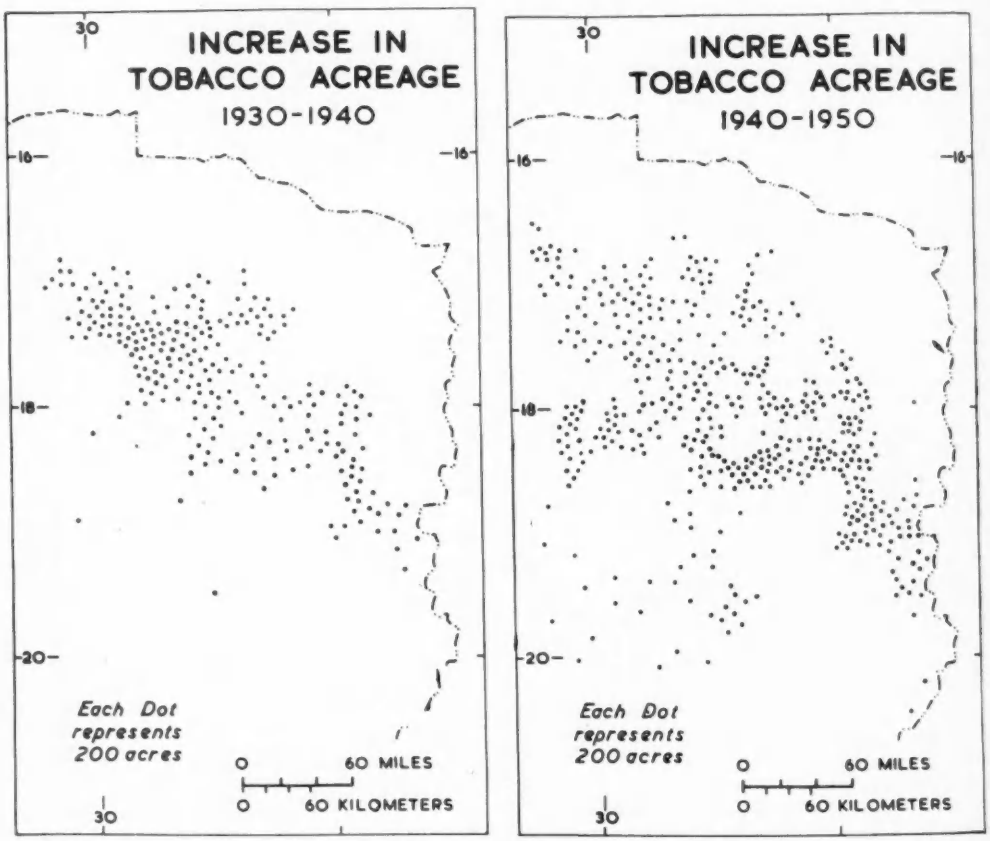


FIG. 7 (left). During the thirties, when competition in overseas markets was acute, expansion in tobacco acreage was greatest in areas of suitable soils within easy access to Salisbury. Consequently, of the total tobacco acreage, the proportion in Lomagundi, Mazoe, and Salisbury rose from nearly 50 to more than 70 per cent.

FIG. 8 (right). During the forties, under the stimulus of high prices, tobacco cultivation spread northward and southward away from the railroad, and, more especially, southwestward along the railroad into Hartley. At the same time, in sharp contrast to the two preceding decades, expansion was greatest in the southeastern districts of the Tobacco Belt—notably in Marandellas and Makoni.

the gray surface soils are invariably shallow. Consequently, because the tobacco plant is deep rooting, the character of the subsoil, particularly with regard to drainage, markedly influences the crop.

Sandy loams of a finer texture occur at the contact between granite and diorite, schist and basalt, granite and schist, sandstone and basalt, and granite and banded ironstone. These "contact soils" form isolated pockets of high fertility, which furnish heavy yields of good-bodied bright leaf, silky in texture, and uniform in color. Given adequate drainage and a high humus content, contact soils are excellent for seed beds and cigar tobacco.

Normally, however, sandy loams are lacking in plant foods. Accordingly, coarse-textured granitic soils are usually given 350–600 pounds of fertilizer mixture per acre and finer-textured sandstone soils 150–300 pounds. Contact soils may receive 100 pounds or less. The standard fertilizer mixture comprises 6 per cent nitrogen, 10 per cent phosphate, and 8 per cent potash. To prevent rapid leaching of the fertilizer, compost or kraal manure is applied at the rate of five to ten tons per acre.

Fire-cured tobacco grows best on friable clay loams derived from dolerite, diorite, schist, and banded ironstone. Soils derived from dolerite and banded ironstone are heavier and far less extensive than those derived from diorite, while schistose soils are lighter and relatively unimportant. Both dolerite and diorite give deep, well drained, and highly fertile soils, but schists and banded ironstones may yield shallow soils of only moderate fertility. All are reddish brown in color, contain high, though varying, percentages of clay, silt, and humus, receive 400–600 pounds of fertilizer mixture per acre and eight tons of compost or kraal manure. The lighter, well-drained soils are also used for flue-cured tobacco, though only virgin soils yield a bright leaf. Of late, they have occasionally been planted with cigar tobacco, furnishing mainly filler and binder leaf.

Fire-cured tobacco plants, and more especially seedlings of all tobacco types, are often grown in fertile, well-drained, alluvial soils rich in humus. These soils are ideal for seed beds, not only because of their texture and fertility but also because of their location near available water supplies. Nevertheless, much low-lying alluvium tends to become waterlogged during the rains, so that the provision of artificial drainage is sometimes necessary, particularly for Turkish tobacco which is sown late in the season when the rainfall is heavy. All seed beds, whether of alluvium or sandy loam, are given dressings of wood ash, compost, and fertilizer (superphosphate, nitrate of soda, and sulphate of potash).

CLIMATE AND CROP REGIME

In Southern Rhodesia, where the winters are almost rainless, seed beds for both flue-cured and fire-cured tobacco are sown at the onset of the spring rains. The rainfall, distributed fairly evenly over the entire Colony, is largely convectional. Thunderstorms occur intermittently in October, the second month of the hot season, and with increasing frequency in November, the hottest month of the year. Where seed beds are located on terraced slopes, protection from stormwaters is necessary. For maximum insolation an eastern or northeastern aspect is preferred. Frequently shelter from prevailing winds is provided by artificial windbreaks, which usually consist of reeds or maize stalks interlaced and attached to wires suspended between posts. Flue-cured tobacco is sown from mid-September to the end of October and fire-cured tobacco in

October and November. The transplanting of flue-cured tobacco begins in November.

Summer rainfall, heavier in the northeast than elsewhere in the Colony, is derived from the monsoonal inflow from the Indian Ocean. Throughout December, although precipitation occurs mainly during afternoon or evening thunderstorms, there is nevertheless a general increase in cloud cover; and cloudy days with frequent showers of rain provide ideal conditions for transplanting tobacco. Similarly, in January and February, when thunderstorms are less frequent and the diurnal distribution of the rainfall is more even, steady rains, combined with high insolation, provide ideal growing conditions. The rains reach a maximum early in January, when the sun is overhead, and throughout the rest of the summer, steadily decrease. Normally, therefore, flue-cured tobacco seedlings are transplanted before the end of December, but fire-cured tobacco is seldom transplanted before January. Turkish tobacco requires appreciably less rainfall than Virginia, so that seed beds are not sown until December or early January and transplanting takes place only in late January or February. On the other hand, cigar tobacco requires the heavy rainfall of the eastern mountains, where the monthly precipitation reaches a pronounced maximum in February. Accordingly, seed beds are sown in mid-December and seedlings transplanted early in February.

Harvesting and curing take place in the late summer and autumn, when the rainfall, associated with tropical cyclones of the South Indian Ocean which have little influence so far inland, is invariably small. The crop begins to ripen about three months after transplanting, so that flue-cured tobacco is harvested mainly in March, fire-cured tobacco in April, and sun-cured Turkish and air-cured cigar tobacco in May. Sun-curing, which requires one or two months of abundant sunshine and little or no rain, is everywhere possible in Southern Rhodesia, but air-curing, which requires two or three months of clear, calm days with a moderately dry atmosphere and temperatures of 80° to 90° F., is possible only in sheltered and favored localities.

FIG. 9. Watering seed beds on a tobacco farm near Rusape. The young plants are protected from the direct rays of the sun, and, incidentally, from insect pests too, by a covering of cheesecloth, though on some farms combed grass or sunhemp stalks, far less satisfactory covers, are used. Note the typical savanna landscape and the underdeveloped nature of the farm. (Courtesy of E. T. Brown, Umtali.)

THE NORTHWESTERN TOBACCO REGION

The Tobacco Belt may be divided into three agricultural regions, of which the northwestern, comprising most of the European farmland of Lomagundi and Urungwe, is separated from the rest of the Belt by the Umvukwe Range. On the southwest it is bounded by the Sanyati River valley, where conditions are unsuited to European settlement, and by the Magondi and Urungwe native reserves; to the north the limits are those of European land settlement, as determined largely by distance from railhead. In general, physical and economic conditions affecting tobacco production deteriorate northwestward. Thus, around Trelawney, soil and cli-

matic conditions are ideal, but around Sinoia, farther from the Salisbury market, soils are more suited to maize growing, and in Urungwe, far from railhead, the rainfall is marginal. In Urungwe, however, where since World War II the frontier of European settlement has advanced steadily northwestward, every farm, with only one exception, has tobacco as the principal crop.

In 1950, of the total acreage under flue-cured tobacco in Southern Rhodesia, the northwestern region contained one-fifth, compared with one-third in the thirties. Maize occupies a slightly greater acreage than tobacco, but, even so, flue-cured tobacco is the main crop on nearly nine-tenths of the European farms. Lomagundi is in fact the premier tobacco district and ranks fourth as a maize producer. Tobacco yields per acre are normally higher than the Rhodesian average (565 pounds), and of late, with improvements in cultivation methods and the development of virgin land, some exceptionally high yields have been recorded. The crop occupies about 70 or 80 acres per farm, and for every 10 acres a curing barn is usually provided. The standard curing barns (16 feet wide, 20 feet long, and 16 feet high) are operated with wood furnaces, but coal furnaces, which are more efficient and permit greater heat control, are becoming more common in the southeast. On the farms the leaf is cured, conditioned (exposed to damp atmospheric conditions), and then bulked. Although some growers also grade and pack their tobacco and dispatch it direct to the auction floors in Salisbury, most growers prefer to have their crop graded and packed at "commercial grading warehouses." The region contains only six warehouses: two at Sinoia, one at Banket (midway between Sinoia and Trelawney), one at Trelawney, and two at Darwendale. In Southern Rhodesia auction sales are not held at warehouses.

Turkish tobacco is essentially a subsidiary crop, so that the number of growers varies greatly with changing market conditions. In 1945–46, at the height of the recent boom in Turkish tobacco, more than nine-tenths of all tobacco farmers in the northwestern region grew Turkish varieties, but since then the proportion has fallen to little more than one-tenth. Production is concentrated in southeastern Lomagundi, where the Turkish Tobacco Co-operative Society provides farm requisites at reduced prices and technical advice regarding cultivation and curing. Although the average acreage per farm is here substantially higher than elsewhere in the Colony, it rarely exceeds 25 acres and is usually only about 12 acres. Yields per acre are generally much greater than the Rhodesian average of about 380 pounds. The chief varieties grown are Soulouk and Kavalla. The crop requires less capital than flue-cured tobacco, for the leaf may be cured on rocks in the sun, a conditioning pit to facilitate handling may be constructed cheaply, and the only building necessary is a storage shed. In practice, however, regular growers prefer to use fixed curing racks (movable curing frames are rarely used), which are located on well-sheltered, level land near the storage shed and conditioning pit and aligned from north to south to maximize insolation. Some 400 feet of racks, all of which have to be covered at night or in wet weather, are necessary per acre of tobacco planted. Baled leaf on the string is transported to the Co-operative Society's warehouse at Darwendale, where it is graded, blended, fermented, and repacked for export.

THE CENTRAL TOBACCO REGION

The central region includes most of the European farming areas of Hartley,

Salisbury, Mazoe, and Darwin. It is separated from the southeastern region by native reserves, the 5000-foot contour, and the limit of the clay areas northeast of Salisbury. Elsewhere, if the artificial limits imposed by native reserves be excluded, the regional boundaries, except for the Umvukwe Range and the low-lying country west of Gatooma, accord closely to the 30-inch mean annual isohyet.

The region furnishes not only one-third of the Colony's output of flue-cured tobacco but also one-half of its maize. Clay loams predominate, particularly near the railroad, so that maize occupies nearly three times the acreage under tobacco. The proportion of European farms with tobacco the principal crop, the average tobacco acreage per farm, and the average yeild per acre, are all significantly lower than elsewhere in the Tobacco Belt. It is noteworthy that the relative importance of tobacco in the farming system is least around Salisbury, greater in Hartley, greater still in Mazoe, and greatest in Darwin—a reflection of the heavier transport costs for maize than for tobacco. In general, farming is more diversified, especially around Salisbury, than in the other tobacco regions, so that tobacco production is more sensitive to price changes and post-war expansion has been considerable. In areas remote from the railroad, where ranching was hitherto the dominant activity, the existence of a main road to railhead, such as that from Mtepatepa to Bindura, or to the Salisbury market, such as that from Beatrice, has been an important factor in recent expansion. The region contains 19 of the Colony's 40 warehouses: Salisbury has 13, Bindura two, and Concession (west of Bindura), Lytton (southwest of Salisbury), Hartley and Gatooma each has one.

Whereas the northwestern region produces two-thirds of the Colony's Turkish tobacco, the central region produces only one-fifth. Even in 1945–46, little more than half the tobacco farms grew Turkish leaf, and in 1950 the proportion was as low as 4 per cent. But owing to

FIG. 10. Transplanting tobacco seedlings on a farm near Rusape. The seedlings, about 6 inches high, are planted in parallel ridges aligned from east to west. Ideal conditions for transplanting are an overcast sky and frequent showers of rain. (Courtesy of E. T. Brown, Umtali.)

the diversified farming and the ease with which Turkish tobacco can be produced, many farmers who are not growers of flue-cured tobacco nevertheless cultivate small acreages of Turkish tobacco. Consequently, the crop area per farm rarely exceeds five acres. Yields are also low, being highest in the Mazoe district, where the rainfall is comparatively low, and lowest in the Hartley district, where the heavy soils are more moist. Production is, however, concentrated on the sandy loams east of Darwendale.

Today, the Rhodesian production of fire-cured tobacco is substantially greater and much less widely distributed than the production of Turkish tobacco, but the number of growers of each type is about the same. Fire-cured tobacco is grown exclusively on the clay loams of eastern Mazoe, though it could be grown equally well in similar areas of Hartley, Salisbury, and Lomagundi. Even in Mazoe, however, it is grown by only one-sixth of the tobacco growers. Characteristically it is a side-line on maize farms, though in drought years it may become the more important cash crop. Only about three-tenths of the crop is grown on farms producing flue-cured tobacco. The average acreage per farm varies between 40 and 45 acres, and yields are about 550 pounds an acre. Five acres only are planted for each curing barn. The chief varieties grown are Western and Little Crittenden.

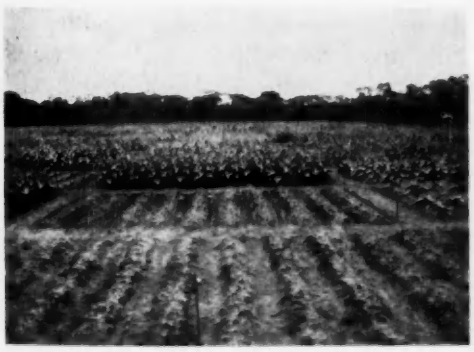


FIG. 11. Experimental plots at the Tobacco Research Station, Trelawney. The windbreak consists of *Brachystegia randii* woodland, locally known as *msasa*, which is the natural vegetation throughout most of the Tobacco Belt. (Courtesy of the Public Relations Department of Southern Rhodesia.)

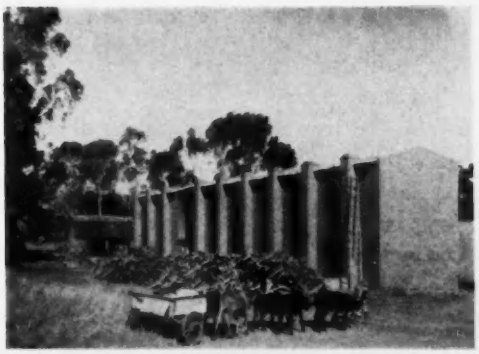


FIG. 12. Flue-curing tobacco barns operated with wood furnaces. In 1949 to 1950, of the 17,985 tobacco barns in use in Southern Rhodesia, 14,972, or 83 per cent, were operated with wood furnaces, 2108 with coal furnaces, and 8 with oil burners. (Courtesy of the Public Relations Department of Southern Rhodesia.)

FIG. 13. A tobacco auction sale in Salisbury. (Courtesy of the Public Relations Department of Southern Rhodesia.)

THE SOUTHEASTERN TOBACCO REGION

The southeastern region, which comprises most of the European farming areas of Umtali, Makoni, Marandellas, Mrewa, and Mtoko, has rigid boundaries on all sides. Except for a small tract east of Marshbrook, where the boundary is that between the Marandellas and Charter districts, both the northern and southern boundaries are fixed by native reserves and "native purchase areas."

To the east the Mozambique border, together with the mountains northeast of Rusape, imposes equally rigid barriers, so that future expansion will be possible only southward from Marshbrook and, to a lesser extent, from Umtali.

Within the region an extensive tract of highland, unsuited to tobacco culture, is followed by the railroad from Bromley eastward to Rusape. Tobacco can, therefore, only be grown either at some distance from railhead, as in Mrewa and Marandellas, or, if near the railroad, at considerable distance from Salisbury, as in Makoni and Umtali. Although tobacco has long been cultivated, particularly in Marandellas and Mrewa, mixed farming, in which tobacco had little place, remained until recently the typical system. After World War II, however, when high prices removed the locational disadvantage, expansion was strikingly rapid, and, significantly, was greatest in Umtali, the district farthest from Salisbury and the least suited physically to tobacco culture.

In 1950 the southeastern region accounted for more than one-third of the total tobacco production. The average farm has about 90 acres under the crop, and average yields are as high as those in the northwest. Tobacco is, however, the main crop on only three-quarters of the farms; the proportion is especially low in Umtali, where the lowest yields of the region are recorded. Clay loams are largely absent, and maize occupies a smaller acreage than tobacco. The region contains eleven warehouses: Bromley, Headlands (east of Marandellas) and Rusape each have one; Macheke and Inyazura each have two; and Marandellas has four.

The southeastern region contributes only one-tenth to the Colony's Turkish tobacco output. The crop is grown as near to Darwendale as possible, mainly in northwestern Marandellas and southwestern Mrewa. In 1945–46 about one-third of the tobacco farms grew Turkish leaf, but since then the proportion has sunk to less than 3 per cent. Although many farmers who are not growers of flue-cured tobacco grew Turkish tobacco during the boom, the crop today comes almost exclusively from Virginia tobacco farms. The average acreage per farm rarely exceeds 10 acres, though the average yields per acre are almost as high as in Lomagundi.

OTHER TOBACCO AREAS

Tobacco is grown in three other areas, each distinct in its physical and economic conditions. The Charter and Gutu districts, which at present furnish about 4 per cent of the total output, enjoy excellent soil and climatic conditions, but have to bear heavy transportation charges. Even so, tobacco has long been the main cash crop on at least one-sixth of the European farms, and of late the proportion has risen to one-half. In 1945–46 the output was almost entirely Turkish tobacco; in 1950 it was almost entirely flue-cured Virginia. The region is served by warehouses at Enkeldoorn and Umvuma.

In general, the same is true of the Gwelo, Selukwe, Chilimanzi, and Victoria districts, which together furnish 3 per cent of the total output. Again, flue-cured tobacco has almost wholly replaced Turkish tobacco, but here tobacco has never been important, despite the existence of rail facilities, owing to a lower and less reliable rainfall. Only of late has tobacco become the principal crop on European farms, and even so tobacco farms number only one-tenth of all farms in the area. There are warehouses at Que Que and Umvuma.

The Melsetter and Chipinga districts, which furnish only one per cent of the output, lack warehouse and rail facilities

FIG. 14 (left). Because the lower leaves of the tobacco plant usually ripen first, the single leaf or "priming" method of harvesting, which enables the curing barn to be filled with leaf uniform in ripeness, body, and texture, is generally practised in Southern Rhodesia. From three to six pickings are necessary to complete the harvest. (Courtesy of the Public Relations Department of Southern Rhodesia.)

FIG. 15 (right). Loading bales of Rhodesian tobacco at the port of Beira. (Courtesy of the Public Relations Department of Southern Rhodesia.)

but in places have suitable soils and an adequate rainfall. Virginian tobacco has always been dominant, and over the past decade the negligible acreage under Turkish tobacco in Chipinga has remained constant. In Melsetter the product is entirely flue-cured leaf, and in Chipinga it is mainly cigar leaf. Cigar tobacco is never the principal crop. Ohio Seedleaf, Zimmer Spanish, Cuban, and Comstock Spanish are the main varieties grown for filler leaf, Comstock Spanish and Connecticut Havanna for binder leaf, and Connecticut Broadleaf, Cuban, and Sumatra for wrapper leaf.

LABOR

The future development of the tobacco industry may well be handicapped by an inadequate supply of African labor. Despite a large native population, the Colony has always been faced with recurring labor shortages, but in the past they have been met by more intensive recruiting in neighboring territories. Today, these territories, which furnish more than two-thirds of the labor employed on tobacco farms, are making increasing demands upon the available supply for their own development. Despite intensive recruiting campaigns, the flow at best remains constant, and if one excludes drought years, such as 1949, when famine forces Africans into European employment, the flow is even diminishing. Fortunately, however, the rate of decrease is least for Mozambique, which normally supplies about one-half of the Colony's migrant force, about average for Nyasaland, which supplies about one-third, and greatest for North-

ern Rhodesia, which supplies most of the remaining one-sixth.

Although tobacco farming requires a far greater labor force per acre than any other type of Rhodesian farming, many tobacco farms, perhaps as many as one-third, are wholly dependent on this declining supply of migrant labor. Such labor is in any case notoriously unstable. Migrants seldom stay for more than three years, and the majority change employment or return home within a year of arrival. Moreover, on return to Southern Rhodesia, an African frequently takes up a different type of job to his previous one, or occasionally the same type in a different area of the Colony, so that his efficiency inevitably remains low. Formerly, the bulk of the labor force was paid off or dismissed during two or three months of the dry season, but owing to the growing labor shortage, many farmers now retain labor, even in idleness, for as long as possible. At the same time, Africans are being encouraged to settle on the farms with their families, not only because resident families tend to remain longer but also because the wives and picanins may be employed as casuals to tend cattle or to work on the tobacco crop. The average farmer employs about 20 casuals in addition to some 80 regular employees.

A general decline in the output per worker, despite greater mechanization in recent years, has aggravated the labor shortage. Farmers are almost unanimously agreed that the African regards machinery as a means not of increasing output but of facilitating work. Consequently, recent mechanization, far from effecting any labor saving, has merely resulted in reduced effort and a lower efficiency. In any case, only limited mechanization has as yet been possible. Such operations as seeding, transplanting, priming, topping, suckering, harvesting, and grading, still necessitate manual labor. Thus mechanization of preliminary field work merely accentuates the seasonal variations in labor demand.

The labor supply problem can be solved only by an improvement in the efficiency both of labor itself and of labor utilization. On tobacco farms, neither the number of workdays nor the number of hours worked per week are as heavy as in industry, though they are of course less regular. Most farmers cater for peak periods by employing more labor—on the average about 25 per cent—than is normally necessary. But the peak labor demands are of such short duration and so far apart that they might be easily satisfied by the adoption of a double shift system or by the payment of overtime rates on a piece work basis. Alternatively, the introduction of a more diversified farming system, including an extension of animal husbandry and the incorporation of grass leys in crop rotations, would not only make more effective use of the labor force but also help to maintain soil fertility and to stabilize the farming system. In any event, because most tobacco farms are underdeveloped, surplus labor could be absorbed in an extension of land use. Meanwhile, to ensure a stable, if not expanding, supply of efficient labor, perhaps the prime necessity is to give the African some agricultural training and thereby make him interested in his work.

MARKETING AND EXPORT

The Southern Rhodesia Tobacco Marketing Board, appointed in terms of the Tobacco Marketing Act of 1936, exercises control over all stages in the sale and export of Virginia tobacco. Growers of flue-cured and fire-cured tobacco may either sell their crop over licensed auction floors or obtain a permit

to export it on consignment. Although the first auctions, in 1910 to 1914 and again in 1928, eventually failed, the system has worked so smoothly and efficiently since 1936 that the entire crop has in recent years been sold by auction. As auction sales are confined to Salisbury, where there are at present only two auction floors (shortly to be increased to three), the city claims to be the largest individual tobacco market in the world. Auction sales extend from April to October. The amount sold daily ranges from 3000 to 5000 bales (each weighing about 175 pounds), according to the capacity of the railroad to handle exports. Between May and November, 1950, the railroad transported an average of 1575 tons of tobacco weekly to the port of Beira. Storage capacity at the port has recently been increased to 5000 tons, but this appears inadequate for future needs.

Of the total amount sold by auction, over four-fifths is normally exported. In 1950 neither cigar nor sun-cured nor air-cured tobacco was exported, but usually small quantities of each type are sent to Great Britain. Exports of fire-cured tobacco in 1950 amounted to 737,000 pounds, of which more than half went to the United Kingdom, most of the rest to neighboring territories, notably Bechuanaland, and a small quantity to the European continent. In recent years, owing to currency devaluations, the demand for fire-cured tobacco on the European continent has greatly increased, and although Italy promises to be a formidable competitor, Southern Rhodesia is fostering production in an attempt to capture the markets.

Exports of flue-cured tobacco in 1950 amounted to 88,016,000 pounds, of which more than two-thirds was sent to the United Kingdom and most of the rest to Australia, Denmark, Egypt, and South Africa. The United Kingdom market, upon which the flue-cured tobacco industry almost entirely depends, is at present protected from American competition both by tariff preference and the dollar shortage. Once the dollar position returns to normal, the prosperity of the Rhodesian industry will presumably fluctuate according to the amount of the preference, unless either recent changes in manufacturing practice, together with intensive agricultural research, enables Rhodesian leaf to compete on equal terms with American leaf, or the industry receives added protection. At present, a market for about 75 to 85 million pounds per annum of flue-cured tobacco is guaranteed under long-term agreements between Rhodesia and the United

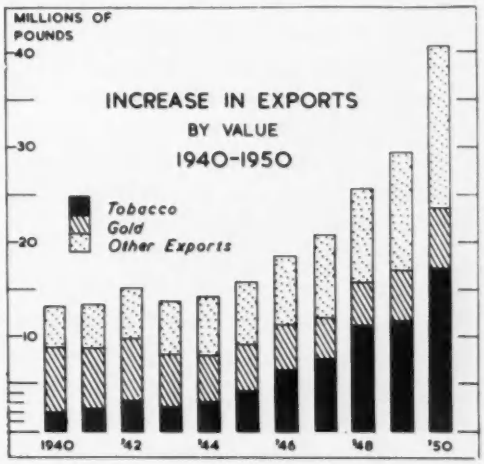


FIG. 16 In 1945 unmanufactured tobacco surpassed gold bar as the premier export of Southern Rhodesia. Whereas in 1940 gold furnished 52 per cent of the total exports and tobacco only 15 per cent, in 1950 they furnished 16 and 42 per cent respectively.

Kingdom. During the years 1951 to 1956 United Kingdom manufacturers will buy up to 485 million pounds of flue-cured leaf, provided that the annual amount offered does not exceed two-thirds of the total crop, that the leaf is of suitable quality and reasonably priced, and that tobacco consumption in the

United Kingdom does not fall appreciably.

Less than one-fifth of the Virginia tobacco crop, and none of the Turkish tobacco, is retained for manufacture in Southern Rhodesia. Five factories, of which three are located in Salisbury and two in Bulawayo, manufacture cigarettes and pipe tobacco, mainly for local consumption. Nevertheless, about one million pounds of cigarettes and about half a million pounds of pipe tobacco are exported annually, chiefly to Northern Rhodesia but also to the Belgian Congo, Bechuanaland, Nyasaland, and other African territories.

Under the Turkish Tobacco Act of 1948, all Turkish leaf grown in the Colony must be sold through the Cooperative Society at Darwendale. A grower wishing to export direct can do so only under special permit. Turkish tobacco is in fact a dollar-earning commodity: the American demand for the better grades exceeds the supply. Of the 4,859,000 pounds produced in 1946, as well as of the meager 563,000 pounds exported in 1950, the United States took one-half. Other regular importers are the Argentine, the United Kingdom, Canada, the Netherlands, and Denmark.

CONCLUSIONS AND THE FUTURE

The future development of the Southern Rhodesian tobacco industry depends not on physical conditions, for there are at least two million acres of European-owned land suited to flue-cured tobacco, but on the maintenance of an adequate labor supply and of high prices for tobacco. Much of the recent expansion, except for that in the southeastern region, has resulted from the spread of cultivation into marginal areas and from an increase in the acreage on established farms beyond the limit imposed by labor potential and barn accommodation. The existing Tobacco Agreement with the United Kingdom should enable output to expand to at least 140 million pounds annually, but such expansion may well be attended by excessive production of low-grade leaf. Although tobacco culture is a specialized occupation, it is at present excluded from the curriculum of the Gwebi Agricultural College near Salisbury, so that many new farmers lack both experience and training in tobacco production. If the price of tobacco should fall appreciably, it may be necessary for the Southern Rhodesian Government to screen new entrants to the industry and to allocate acreages to existing growers according to their efficiency over several seasons. This would probably eliminate tobacco from the outside districts and reduce acreages, perhaps substantially, at the extremities of the Tobacco Belt. But the southeastern region will undoubtedly remain, as it has so recently and rapidly become, an important tobacco producer, and the outline of the Tobacco Belt, despite internal redistribution of production, is unlikely to undergo further radical change—at least, not in the immediate, foreseeable future.

EROSION OF FARMERY SITES IN THE NASHVILLE BASIN OF MIDDLE TENNESSEE

J. R. Whitaker

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TRAVELERS along the roads which radiate across the Nashville Basin from Nashville, Tennessee, can see that many farmsteads[1] are located on bare limestone bedrock, or on sites with soil so thin that the gray bedrock outcrops in many spots. The placement of these farm houses and barns on non-agricultural land resembles the common location of Old-World villages on rocky sites, particularly around the Mediterranean Sea, and calls to mind the oft-repeated assertion that the villagers deliberately and wisely put their houses and work buildings on land not fit for agriculture. That the persons who located these Tennessee farmeries on rocky sites made a like choice in order to leave thick-soil lands for crops may seem, at first, a reasonable explanation, one that is supported, moreover, by the certainty that settlers found much bare bedrock when they pioneered this area.

And yet the hypothesis that farmers deliberately built these houses and barns on bare limestone outcrops and areas of shallow soils to free the soil-thick areas for crops and pasture leaves disquieting doubts. When these farms came into being, probably more than 80 years but not more than 170 years ago, there was no pressing need to economize on cropland; whereas there was real need for good garden plots, cropland, and pastures near the house. Even a casual examination of these bared sites, moreover, shows that they are related neither to topographic nor bedrock conditions: they are correlated with no particular surface traits, and are found on essentially horizontal limestones.

No satisfactory explanation occurred to the writer, however, until he read that Indian farmers in southern Brazil have found it necessary to go farther and farther from their houses to find cassava land, as that near their dwellings is worn out. This report set up a train of thought which bore fruit in another interpretation of the association of Middle Tennessee farmeries and bare bedrock, namely, that the barrenness of the land near the house and barn developed *after* the buildings were located there. This hypothesis provided the incentive for further study of the question.

The location of the author's home within the Nashville Basin made investigation of this problem relatively easy, not only through casual observations in crossing the Basin but in more formal field work. At first an effort was made to check all farms along a given traverse. It was soon clear that the bedrock exposures were largest and most conspicuous near the oldest barns

[1] The term "farmstead" is used as a synonym for the uncommon but more precise word "farmery," defined in the "Oxford Dictionary of the English Language" as including the house, barn, work buildings, and surrounding and adjacent yards.

and houses. Thereafter attention was largely focused on them. Numbers of farmeries were studied individually, and appropriate notes taken of soil conditions and land use. Numerous photographs were taken and many farm operators interviewed. Several traverses across the Nashville Basin were made.

Fortunately for the success of this study, settlement along roads radiating from Nashville into the Nashville Basin is not so old but that cabins and barns dating back to early settlement—log-cabin days—still remain in great numbers. The study of these older farmeries provided a convincing answer to the problem. The association of house, barn, and yard with outcrops of bare bedrock is, indeed, a causal one, but it is *not* an example of wise adjustment by pioneer farmers to differences in the natural qualities of the land. The farm centers were *not* originally placed on areas of bare bedrock or exceptionally shallow soil. Rather, each farmery became a center of soil erosion. The activities that center on the barn and house have laid the bedrock bare. It is arresting to see bared rock platforms from which practically all of the soil has been removed, but even more impressive are occasional yards where erosion has etched deep trenches along joints in the limestone beds, so that limestone blocks project several feet above the level of the livestock trails that wind among them.

SCALPING FARMERY SITES IN THE NASHVILLE BASIN

The processes of destruction have differed somewhat in the barnyard, the houseyard, and the fields surrounding the farmery.

The first inkling of the causes of the bedrock outcrops grew out of the recognition that bared bedrock surfaces do not completely surround each house. Next came the realization that the worst conditions are nearly always in the yards near the barn. The principal destruction has taken place in the fenced stockyards associated immediately with the barn, whether feed lots, hog lots, barnyards, or what.

When one sees barnyard after barnyard with the gray limestone exposed to view but fails to find such outcrops in the fields adjacent, one is certainly on a warm trail; and when repeated checks show that the outcrops extend to the fence line but commonly fail to appear on the other side, the quarry is in sight. The game is treed when soil-auger borings indicate that the soil on the outside of the yard is considerably deeper, as a rule, than that on the inside. Repeatedly in this Middle Tennessee area the writer has found the mantle rock to be two, three, or even four feet deeper in the areas immediately adjacent to these barn lots than in the lots themselves. The coincidence of bare bedrock and truncated soil profiles with the boundaries of the yard, and the more or less rectangular character of those boundaries, leave no doubt that the association of farmery and bare bedrock is a result of land use rather than of deliberate choice of bared rock as the original farmery site.

One can so easily watch the processes of destruction that have brought this condition about that one is perplexed at having entertained a different hypothesis regarding the association of farmery and rock outcrop. To take one example: a certain farmery has two hog lots, a mule lot, and a relatively large fenced cow pasture surrounding the barn. The pigs have so trampled and uprooted the mantle rock that there is not a sprig of grass anywhere. In the adjacent lot mules have likewise destroyed every bit of vegetation. In all

three plots rock outcrops extend to the fence which separates them from a cornfield, in which a soil auger was bored down to its full length without reaching bedrock. The lot reserved for cows—about four acres—was somewhat larger than usual, but I think the explanation was contained in a statement by the tenant (who acknowledged that he had not been on the place very long) that there was no soil near the barn. It is reasonable to suppose that the grazing area may have been enlarged as land nearer the barnyard ceased to be of use for pasture.

Destruction in the barnyards is due, not only to overgrazing and to trampling and uprooting of the soil by livestock, but also to wear by wheeled vehicles. The lanes that reach to the main highway and to different parts of the farm focus, of course, on the barnyards, with the result that deeply cut ruts channel eroding water.

As though this were not enough, the accumulation of animal manures contributes to the same result. Manure is seldom promptly collected and spread on the land. Rather, it is allowed to pile up at the door of the barn and to drain across the yard, with the result that vegetation is killed out, the soggy soil is quickly puddled, and soil structure relatively resistant to erosion has been lost.

Destruction in the yard that surrounds the house, commonly separated from the barnyard by a fence, is generally less severe and much less symmetrical with respect to the central building. Whereas the bared bedrock area commonly surrounds a barn or shed, it is generally on the barnward side of the house. Not uncommonly there is a limestone platform reaching from the side door of the house to the barn. Some of the same processes operate in the denuding of the houseyard foundation, but to occasional grazing and the movement of animals and people may have been added a practice rather general in the South, the clean sweeping of houseyards, a practice gradually declining with the wider use of lawn grasses and lawnmowers.

The almost exact coincidence of the outer boundary of areas of bare bedrock and truncated soil profiles with that of barnyards leaves no uncertainty regarding the cause of soil destruction. Even so, there are many cases where bare rock extends from barnyards into adjacent fields; and in a few places a relatively broad bedrock platform spreads outward for several hundred feet.

There are various explanations for this condition, and doubtless different cases illustrate different causes. There is evidence in some places that the bared rock adjacent to an existing barnyard represents the site of an earlier yard which has been abandoned with the erosion of the soil. After all, if the land has lost all grazing capacity, there is little reason for having a large lot over which the animals run. Another contributing cause has been the use of land for repeated row crops. Corn, tobacco, and cotton have all been usual crops since settlement of the area; corn everywhere, cotton and tobacco less widely distributed. Another cause is the erosion due to trampling as cattle come and go in moving between outlying pastures and the barnyards. The line of convergence of these trails is commonly one or more feet below the level of the adjacent land surface. Finally, one should note that land which has been repeatedly used for row crops and finally abandoned commonly serves as low-grade pasture. As a result of the overgrazing characteristic of such areas the soil is removed more slowly but in

much the same way as in the barnyards.

Both from a study of the correlation of barnyards and eroded areas and from an observation of the present uses of these yards, one thus arrives at the firm conclusion that the processes in operation around the house and barn of the older farms in the Nashville Basin have been highly destructive, with the consequent removal of the entire mantle rock thickness over considerable areas since the days of settlement. Barnyard horses, sheep, and hogs can be as destructive in Tennessee as ranging goats have been in the Mediterranean lands.

It would be a mistake, however, to interpret the results solely in terms of the damage resulting from the trampling hoofs and sharp teeth of grazing animals, from wheeled vehicles, and accumulations of animal manure. We should recognize that the process went on under peculiarly favorable circumstances, for the open weather of winter has made it possible to leave animals outdoors all year long and, moreover, the lack of a snow cover and the prevalence of rain throughout the year result in erosion throughout the entire year. Only during short spells of a few days is the land protected from animals and man by weather so inclement as to force animals indoors or by a snow and ice blanket through which hoofs cannot penetrate.

We should recognize, too, that the process here described is distinctly one associated with a livestock-general farming economy, an economy, moreover, that uses fences as the main means of control of the animals instead of keeping them stall-fed or tethered, both practices of little significance in this country.

Finally, we must emphasize the unique traits of soil and subsoil. There are few smooth to gently rolling plains in the United States where the mantle rock is so thin as here, and where soil texture and structure are so favorable to soil wash. The consequences are all the more striking because this association of bare bedrock with the older houses and barns ends abruptly at the boundary of the Basin.[2] Thanks to the spread of a livestock-general farming economy all over the Basin, here is a man-induced feature of the terrain as distinctive and as characteristic of the region as were the original conditions.

FROM TENNESSEE FARMERY TO OLD-WORLD VILLAGE

The Nashville Basin has dispersed farm settlement, as has nearly all of the United States. However, there is a distinct alignment of farmeries along these old roads and at intervals, where roads cross, are clusters of a few houses, perhaps three to six or eight.

Where this clustering of farmeries occurs, the associated bare rock areas are commonly separated only by fence lines. The result is a relatively large area of rocky land. Where the hamlet is on a ridge or hilltop, bare bedrock crowns the highest areas and extends down the slopes. Where the hamlet occupies a junction of valleys, the valley floors may be soil covered but the surfaces of the lower slopes are rocky—that is, the land around houses and barns. It would be quite excusable if a traveler should conclude that these

[2] Surrounding the Nashville Basin is a plain called the Highland Rim, elevated some 400 feet above the Basin and characterized by level to undulating topography and deep mantle rock, in some places extending downward 20 or 30 feet and everywhere being many feet thick. The Highland Rim farms have essentially the same economy as those in the Nashville Basin. Both are subject to overgrazing, to trampling, and to the other processes that stimulate erosion. In notable contrast to the Basin, however, the barnyards on the Rim seldom show bare rock outcroppings, a difference due, it appears, to the greater depth of mantle rock on the Rim. The great depth of mantle rock is one of the distinct assets of the Rim, and promises an enduring agriculture if the land is used with care.

farm hamlets were deliberately placed on rocky lands, so as to leave deep-soil lands for cultivation!

This observation directs our attention back to Mediterranean villages which are found today on rocky sites. As is well known, the work buildings, as well as the homes of village dwellers, are located in these villages. Such a location encourages the care of animals in shelters and small lots rather than the practice of allowing them to occupy relatively large yards. Accordingly, one would not expect a duplication of the conditions found in and around these Tennessee farmeries. Nevertheless, there have been causes for vigorous soil erosion around such villages. The Mediterranean world has had the goat, death to shrubs as well as to grass. Sheep are almost as destructive. Moreover, trails and roads focus on the village as on the farmery, and livestock kept on outlying land make heavy use of these trails. What is perhaps even more important, the Mediterranean lands have been used for crops (vines, olives, etc.) which can be grown even after the mantle rock has become relatively thin. With a hoe or stick it is possible to scrape together enough soil to grow a plant, and it is possible to break holes in the rock where trees can be made to grow. It is thus true that in both the Mediterranean economy and the livestock economy of Middle Tennessee there are not the usual checks to soil erosion that appear in plow agriculture. I wonder, therefore, if the explanation frequently encountered in studies of Mediterranean villages, that they have been located on non-agricultural land in order to make the better land available for crops, may not be a misinterpretation, in a large percentage of such locations, of a causal connection. The soil immediately around these villages, having been put to early and prolonged use, may well have been removed in much the same way as around the older farm homes of the Nashville Basin of Middle Tennessee.

THE DEVELOPMENT OF INDUSTRY IN EGYPT

Alan B. Mountjoy

Mr. Mountjoy, lecturer in geography at Bedford College, University of London, spent some time in Egypt in 1944 and, since returning to England, has been specializing on Egypt in his research.

THE industrial movement in Egypt stems from several factors—political, economic, and demographic—and has taken place substantially within the last 20 years. The demographic factor is perhaps the all-important one, for the spur of population pressure has become sharper during this time. Egyptian population, now over 19 millions, is increasing at a rate of almost 2 per cent per annum, but her agricultural land is severely restricted by the sterile deserts flanking the Nile Valley and Delta; desert accounts for all but 3½ per cent of the kingdom. The area actually available for cultivation is barely the size of New Hampshire and the population density is now approaching 4 per acre of cultivated land.[1] In recent years as the Malthusian spectre has loomed larger the industrial movement has gathered impetus, for economists have stressed the urgent need for a change in the occupational structure of the population. In the development of mechanized manufacturing industry producing a greater output per head and in the tapping of new resources there seems a way of easing the pressure of numbers on the land, and at the same time of raising standards of living and benefiting the Egyptian nation as a whole.[2]

[1] A. B. Mountjoy: "A Note on the 1947 Population of Egypt," *Geography*, Vol. XXXIV, 1949, pp. 29–37.

[2] A. Bonné: "Movement of Population and Economic Expansion in the Middle East," *Egypte Contemporaine*, Vol. XXXIII, 1942, pp. 319–355.

At the outset it is important that the size of Egypt's present industry be drawn in true perspective, for despite relatively great developments in recent years the country is, and always will be, mainly agricultural. The precise numbers of those occupied in industry cannot be stated owing to varying criteria used in respective censuses and the delayed publication of the most recent (1947) census. It may be taken that some 750,000 were employed in all forms of industrial activity including building and mining, but excluding transport, in 1939. This figure is probably nearer 900,000 today, or still less than 5 per cent of the total population. At least 70 per cent of the Egyptian population is concerned with agriculture.

The principal factors that have hampered industrial development since the first World War are:

(a) The lack of tariff protection (until 1930).

(b) The small home market, due to the low purchasing power and depressed standard of living of the bulk of the population.

(c) The limited range of raw materials available to industry and the lack of cheap fuel.

(d) The shortage of technicians and skilled labor, and the poor quality of the available unskilled labor.

(e) The dearth of capital owing to the overwhelming attraction of land and agriculture. Only as time passed did industrial enterprises

attract investors and were facilities for industrial credits devised.

(f) The sales resistance of a considerable part of the small home market accustomed to good quality foreign goods.

Thus Egypt lacks many of the competitive advantages enjoyed by older countries; *e.g.*, an economic organization tested over some decades, ample supplies of capital and skilled labor, and a plenitude of markets for the disposal of products. With so few industrial assets and so many limitations it seemed that practically all manufacturing enterprises would be stifled at birth unless they could be nurtured under a policy of protection, but it was not until 1930 that the government was free from previous commercial treaties to be able to embark upon such an ardently desired policy. Until that date Egypt had been limited to an import tariff of 8 per cent *ad valorem*, but in 1930 specific duties were imposed—light on raw materials and coal, heavier (6–8 per cent) on semi-manufactured goods, and up to as much as 30 per cent on manufactured articles.

The problem of providing capital for industrial ventures is always a very real one in the Middle East where primary production has created but little wealth among the mass of the population, and where among the wealthy few a tradition of investment in land is widespread. However, under protection, with the greater degree of monopoly it favored, industry became increasingly profitable. Some foreign capital became invested and, of much greater significance, Egyptian capitalists gradually became weaned from real estate and began to interest themselves in industrial promotion. Large sums became invested in industry between 1930 and 1939, and even more during the boom period of the recent war. One measure of the great industrial developments during the thirties is obtained from a comparison of certain imports in 1938 and 1913 (see Table I), while the 1937 Industrial Census puts the proportion of industry founded in the preceding decade at 60 per cent of the total. By 1948 there were 375 Limited Liability Companies in Egypt with a total capital of £E78 millions. Of these 340, with a combined capital of £E69 millions, were entirely Egyptian. (One Egyptian pound [£E] = 100 piastres [PTs] = £1. Os 6d sterling = U.S $2.87.)

The entry of Italy into the war in 1940 and the virtual closing of the Mediterranean began a period of intense industrial development. Foreign imports ceased and local industry found itself in command of the home market;

TABLE I

ITEMS OF EGYPTIAN IMPORT IN 1938 EXPRESSED AS A PERCENTAGE OF 1913 IMPORTS

Machinery and raw materials	*Per cent*	*Finished goods*	*Per cent*
Mineral oils and lubricants	1,403	Iron bedsteads (value)	2
Silk yarn	1,012	Leather shoes	6
Precision instruments	629	Furniture (value)	11
Mazout (fuel oil)	590	Tanned leather	22
Vegetable oils for industry	516	Cement	24
Iron bars	331	Cotton yarn	29
Machines (value)	313	Glassware	45
Cast iron	281	Soap	51
Woollen yarn	180	Cotton piece goods	58

Source: J. Schatz: "Le développement industriel de l'Egypte," *Journal du Commerce* (Alexandria), June, 1940.

it also had to meet increasing requirements of the Allied forces who placed large orders with local firms and made technical advice and assistance available to them. The Services set up their own repair shops, where under the supervision of technical officers local labor learned to tend machines and carry out intricate as well as simple jobs. This policy has led to a substantial increase in the supply of skilled and semi-skilled mechanics, and in general it may be said that the war period did a tremendous amount in developing industrial aptitudes and in expanding the industrial labor force. The establishment of the Middle East Supply Centre in 1941 did much to further industrial activity.

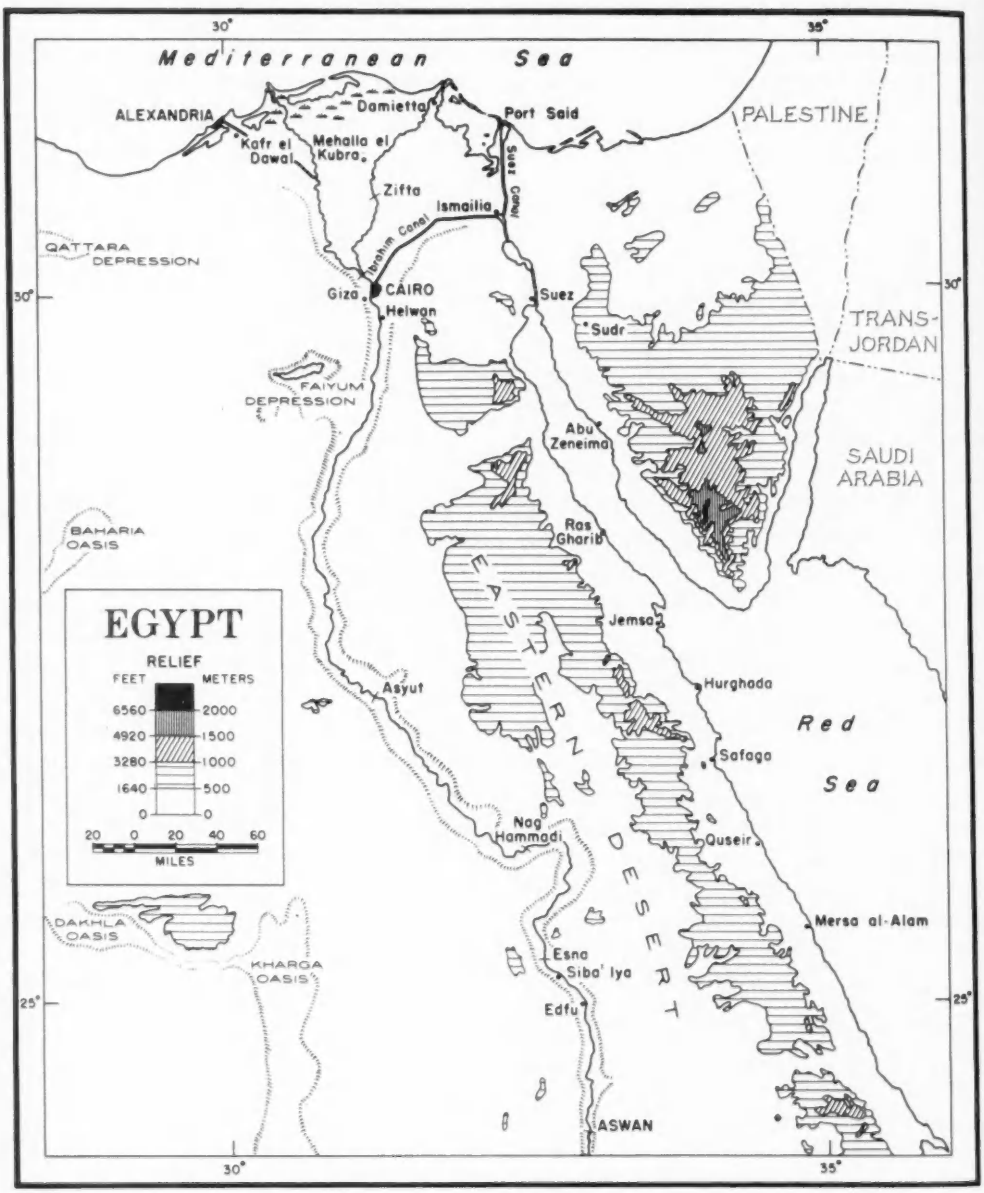

FIG. 1

TABLE II

SIZE OF FIRMS AND EMPLOYMENT IN EGYPTIAN INDUSTRY, 1937–1948

Year	Total no. of establishments	Number of establishments employing						Total number employed	No. of workers per estab.	% of total workers in estabs. employing 5 or more	Av. no. of workers in estabs. with 5 or more workers
		Proprietor only	%	1–4 workers	%	5 or more workers	%				
1937	92,021	48,285	52	36,039	40	7,697	8	273,467	2.97	67	24
1942	103,290	50,709	49	45,172	44	7,399	7	288,260	2.78	72	28
1945	129,231	51,194	40	68,562	53	9,475	7	361,936	2.79	67	25
1948	133,619	45,797	34	77,791	58	10,031	8	395,035	2.95	66	26

Sources: *Annuaire Statistique, 1944–45*, Cairo, 1948, and *Wages and Working Hours, 1948*, Cairo, 1949.

Its object was to see that maximum use was made of local raw materials, and to expand and co-ordinate interregional trade to make the Middle East area as self-supporting as possible.

STRUCTURE OF EGYPTIAN INDUSTRY

Size of Firms

Table II gives an indication of the industrial trend since 1937 and reveals the small-scale nature of the bulk of Egyptian industry. Such development of small-sized firms is understandable; it is a natural development where the market is small, capital scarce, and labor abundant, and partially overcomes the handicaps of limited managerial ability, scanty knowledge of accounting, costing, and statistical techniques. Thus some 92 per cent of the so-called "industrial establishments" are of workshop rather than factory nature (80 per cent of Egyptian firms have a capital investment of less than £E100; under 1 per cent have a capital of £E10,000 or over), a fact that is bound to be reflected in the economic efficiency of Egyptian industry as a whole. This uncapitalized type of establishment with but a small degree of mechanization is denied the industrial economies possible to the large-scale producers and tends to be a high-cost per unit establishment.

At the other end of the scale are a few really large firms of outstanding financial and productive power. The narrowness of the home market (being insufficient to sustain competition between several large mass-producing firms) has been overcome in certain cases by the development of monopoly and cartel features. The sugar, cement, and glass industries provide examples of the former; textiles, cigarettes, and brewing of the latter.

We find that 8 per cent of industrial undertakings (employing "5 or more workers") command 66 per cent of the hired labor force, and within this group are modern highly capitalized factory units typical of a western industrial society. While the overall number of workers per establishment in 1948 was barely 3, a total of 45 undertakings each employed 500 persons or over. These large, fully mechanized establishments, although few, account for the greater part of the output of Egyptian industry. In 1944 out of a total value of production amounting to £E167,000,000, firms with an annual production of £E1,000 or more accounted for £E162,000,000—almost 97 per cent.

The tariff policy, limiting or preventing foreign competition, has been a material factor in the development of such large-scale undertakings. Equally, the small workshop type of establishment owes its continued existence to this policy of protection; however, it does not seem likely in either case that

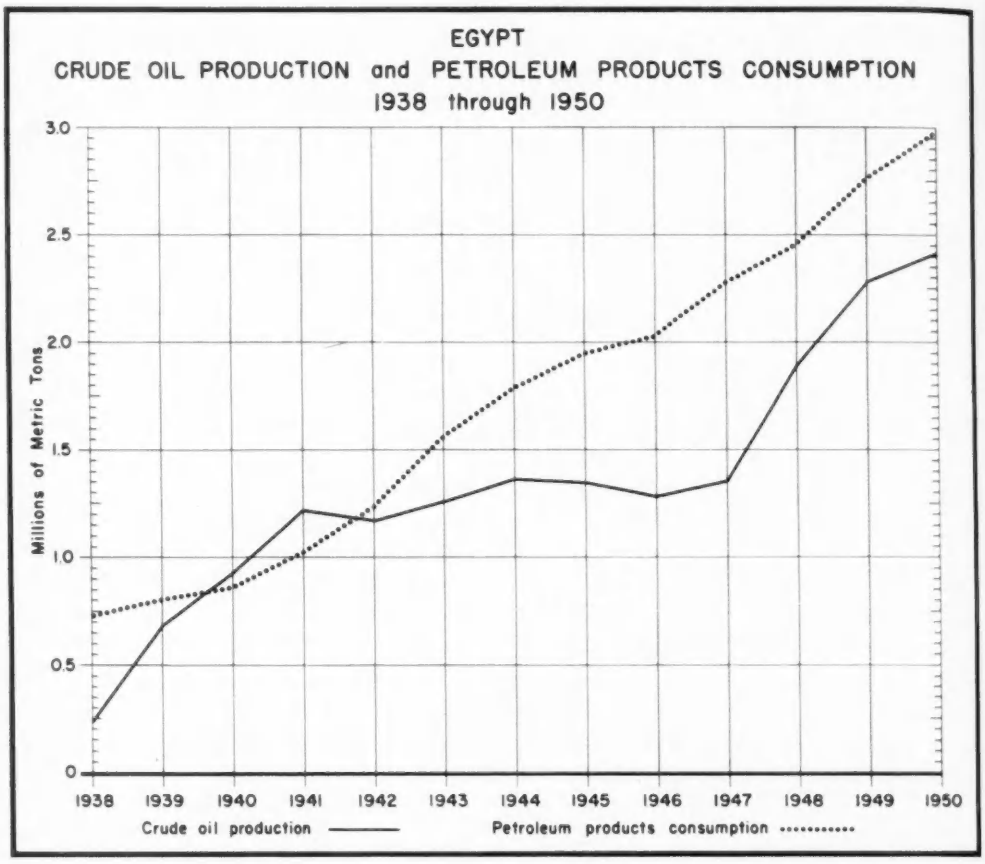

FIG. 2. Crude oil production and consumption in Egypt in recent years. (Compiled from figures supplied by Shell Petroleum Co., Ltd.)

such conditions are advantageous to the consumer.

Power

The problem of the supply of power has delayed the development and helped to shape the course of industry in Egypt. The country lacks coal resources: until the recent war Egyptian fuel requirements were met by imported coal and kerosene, and the output of crude oil from her Red Sea-coast oilfields. Nearly 1.5 million tons of coal were imported annually (80 per cent from Britain), principally for the railways, textile factories, and cement works. With the cessation of coal imports during the war, oil fuel has become the main source of power (usually in the form of electricity) for all the large industries and the Egyptian railways.[3]

Figure 2 illustrates the sharp increase in consumption of oil fuels after 1940 and the inadequacy of Egyptian home production to cope with the rapid expansion of the home market. The balance of oil requirements are imported from Iraq and Persia. Thus the change from coal to oil so far has not made Egypt independent of imported fuel, although her source of supply may now be more assured.

[3] A. McK. Frood: "Some Post-war Economic Developments in Egypt," *Advancement of Science*, Vol. VI, No. 21, 1949, p. 48.

Raw Materials

A brief list of natural resources upon which Egypt's industry is now becoming based emphasizes that she is not well endowed with basic industrial materials, a factor which will set definite limits to the size and extent of her growing industry. Among minerals and salts which provide a basis for mining and chemical industries are phosphates, manganese, crude oil, china clays, iron ore, and natron. Major deposits of these are known to exist or are being actively worked. In addition there are many of the rarer industrial minerals known to exist or already worked in small quantities. They include chromite, magnesite, asbestos, wolfram, talc, alum, and ilmenite. For quarrying, Egypt possesses such major stones as marble, limestone (the basis of a large cement industry), granite, basalt, and alabaster. Agricultural wealth in addition to providing for a wide range of food industries supplies hides and skins for tanning and leather working, and materials for a large textile industry—notably cotton, wool, cellulose (from the cotton linters), and, to a lesser degree, flax and jute. The principal raw materials still imported are silk, jute, tobacco, wood, iron, and steel.

The Location of Industry in Egypt

Location is a significant factor in contributing to industrial efficiency, having an important bearing upon the ultimate cost of the marginal product. An analysis of the various attractive forces, or locative factors—geographical, social, and economic—as well as the results of their interaction embodied in spatial distribution, are of concern to the economic geographer. This applies particularly to Egypt, where the industrial pattern is still in the developing stage, and where such analysis may give useful pointers to future trends.

Figure 3 shows that in 1948 only one-fifth of Egyptian industry was located in Upper Egypt, the remaining four-fifths being in Lower Egypt, that is in the Delta and Suez Canal areas, especially in the urban centers of Cairo, Alexandria, Port Said, Ismailia, Damietta, and Suez (known as the Governorates). We find that there is a particularly marked concentration of industry upon the two main cities, Cairo and Alexandria, and the central provinces of the Delta. Cairo itself has a quarter of the total industrial establishments, and if the adjacent areas in the provinces of Giza and Qalubia are included this "greater Cairo" accounts for almost one-third of all works and fully a third of the total industrial labor force.

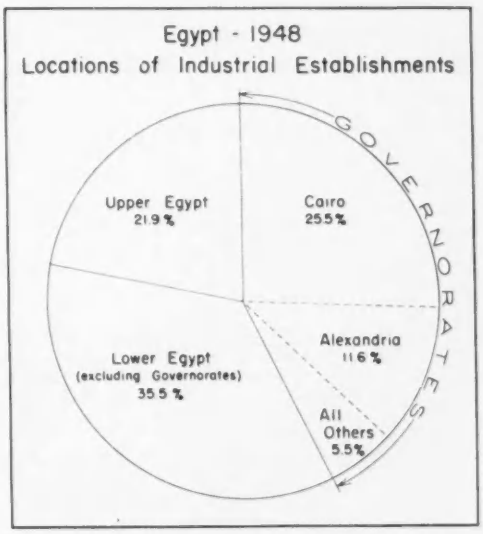

FIG. 3. Locations of industrial establishments. (Compiled from "Wages and Working Hours, 1948," Table I, Cairo, 1949.)

It is not difficult to account for the great attraction to industry of the two major cities. In the first place they provide the greatest concentration of people in Egypt—now over three millions (16 per cent of the total population)—and the areas of greatest *per capita*

wealth and effective demand. Such demand has fostered helpful ancillary services and trades, and the usual "snowball" effect has occurred, for up to a point the more industries that become established in a given area the greater the industrial economies that become possible. Thus proximity to market would seem to be a prime factor in the location of Egyptian manufacturing industry.

These two cities can also offer a more plentiful and regular supply of labor than elsewhere. Further, they were the first centers in Egypt to be able to offer gas, pure water and electricity, and to provide the amenities of civilization to the financiers, merchants, consultants, managers, technicians, etc., who are indispensable to industrial activity, many of whom in the first instance were foreigners accustomed to such amenities. The administrative and commercial importance of these cities, as chief port and capital, are further influences upon industrial location. Alexandria is a well-equipped port linked with the Nile by a navigable canal, and has good road and rail communications with Cairo, the capital and seat of government. Cairo is the focus of the Egyptian railways and has good roads in its immediate vicinity. The Nile and Ibrahim Canal (to Ismailia and the Suez Canal) are navigable to tugs and barges as well as to the small ubiquitous feluccas (Figs. 4 and 5).

In addition to many advantages to be cited for the urban centers, industrial location is also influenced by disadvantages of rural situations. Mainly owing to a deliberate policy of keeping competition against the State Railways down to a minimum, rural communications are very bad. Away from the main centers roads are little more than dirt tracks and, surprisingly, there is no efficient network of navigable canals (of a total of 21,551 kms. of canals only 1,539 kms. are navigable). With a virtual monopoly, rail freights are very high. Thus rural industrial sites are severely limited unless the cost of creating transport facilities is to be borne. The post-war extension of roads is slowly improving this situation.

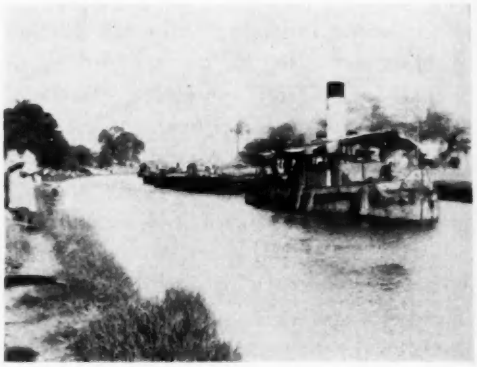

FIG. 4 (left). The Nile provides a useful highway for bulk cargoes; grain, sugar, cotton, cement, phosphates, pottery, move slowly along the 600 miles between the First Cataract at Aswan and the Mediterranean. Above, feluccas from Upper Egypt moored at Cairo.

FIG. 5 (right). Tug and barges on the Ibrahim Canal which links Cairo with the Suez Canal at Ismailia. Only a very small proportion of Egypt's extensive canal system is navigable, and the country possesses a poor road system; the State Railways carry most of the freight.

PRINCIPAL INDUSTRIES

Figure 6 indicates the major industries of Egypt according to the amount

of labor they employ. It will be seen that the *textile industry* takes first place. Before the war, Egypt consumed 38,000 tons of textiles annually, of which she manufactured only 18,000 tons; by 1949, when her consumption had expanded to 45,000 tons, production had reached 51,000 tons. Thus in certain grades of textile goods Egypt now has a small surplus for export. The main factories now have their own dyeing, bleaching, and printing houses and in addition to cloth, cotton-wool, blankets, underwear, and hosiery are made. Expansion of the textile industry continues, and in February, 1951, some 200,000 were employed and capital invested totalled £E25 millions. The industry now uses each year one-sixth of Egypt's annual production of cotton.

The great strides the Egyptian textile industry has made are reflected in the development of the two "textile cities" of Mehalla el Kubra, in the center of the Delta (Fig. 7), and Kafr el Dawal, just south of Alexandria. In both cases "workers' towns" have sprung up around the gigantic mills which are among the largest in the world. The Mehalla mills possess 49 per cent of Egypt's 548,000 spindles and employ 25,000 workers; those at Kafr el Dawal operate 24 per cent of the total spindles and have attracted to their site the large rayon mills which the Misr group (in association with American firms) has constructed since 1946.

Similar expansion is recorded in the woollen industry where production of woollen cloth at 2 million metres had doubled by the end of the war. The silk and rayon industries were less fortunate since they relied upon imported raw materials, and in the war years turned to the manufacture of better quality cotton goods. The company for the production of rayon formed by the Misr group in 1946 is now producing

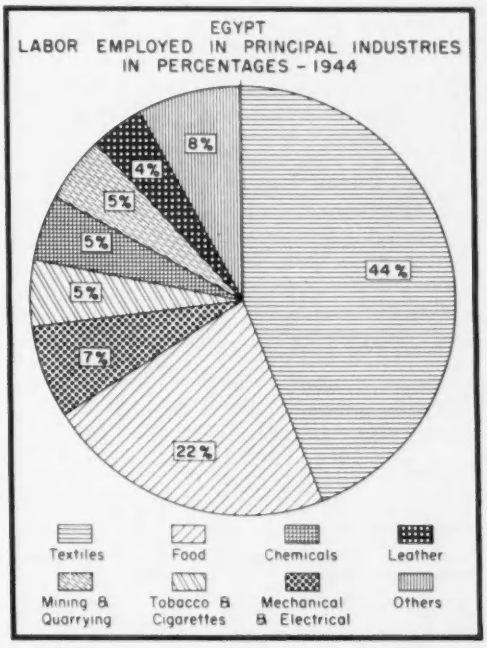

FIG. 6. Labor employed in principal industries. (Based on "Census of Industrial Production, 1944," Cairo, 1947.)

both staple fibre and continuous filament. Two million pounds of rayon fibre were produced in 1949, and by January, 1950, production was at an annual rate of 4 million pounds.

Food Industries

Sugar production has become a highly organized industry under the Société des Sucreries which holds the monopoly of the sale of sugar in Egypt. Five crushing mills operate in the cane-growing districts of Upper Egypt and there is a large refinery at Hawamedieh, near Cairo. Production in 1949 was 190,000 metric tons of refined sugar (160,000 metric tons, 1938), well above estimated annual consumption. The fact that Egypt is more than self-supporting in sugar is to some extent due to the high protection afforded, which allows the internal price of sugar to be much higher than world prices and so restricts home demand. Neverthe-

less, increasing demand from the rapidly expanding population is soon expected to overtake home production. In 1953 production is forecast at about 250,000 metric tons, but demand is then likely to be approximately 300,000 metric tons. The output of molasses is about 80,000 metric tons; a small quantity is exported, but most is used for the production of alcohol, in which Egypt is also self-sufficient.

Oil-seed crushing, one of Egypt's oldest industries, has regained importance since 1940. About 75,000 tons of oil are expressed annually from about two-thirds the cottonseed output of the ginneries. This is double the prewar production and provides not only oil for domestic purposes, but also the major raw material of the soap industry. Other activities within this group include milling, brewing, starch-making from rice and maize, and such new activities as glucose manufacture and the preserving, canning, or dehydrating of fruit, fruit-juice, and vegetables, in which a small export trade has developed.

Chemicals

The chemical industry has also shown expansion since 1940, and in addition to the well-established production of sulphuric acid, caustic soda, and sodium carbonate, new chemicals now produced in small quantities (and mainly related to general industrial activities) include calcium carbide (for welding purposes), sodium hypochlorite (replacing formerly imported bleaching powder for the textile industry), hydrochloric, nitric, and acetic acids, glycerine, ammonia, etc. The production of common salt at Alexandria and Port Said covers all home needs and permits considerable export (see Table III). In 1948, 360,000 metric tons went mainly to Indian and East African ports. The marketing factor in the location and function of this industry is interesting: Alexandria produces almost entirely for the home market and Port Said for export, the salt shipping as ballast through the Suez Canal.

The Metallurgical Industry

This small industry is concerned with the completing of half-finished imports, the refining of scrap metal, the making of nails, rivets, cast iron pipes, lead tubes, etc. There is a small manufacture of steel relying at present upon scrap metal. Two small electrically operated furnaces and a rolling mill are in use; the installation of others is planned. The lack of adequate and cheap local power and raw materials have so far restricted these activities.

FIG. 7. The Misr Spinning and Textile Mills at Mehalla el-Kubra in the heart of the Delta are reputedly the world's largest, employing 25,000 operatives. A well-planned "workers' city" (above) is being developed around the gigantic mills, offering living conditions and welfare services new to the Middle East and on a scale seldom attempted in the West. (Courtesy of the Egyptian Education Bureau, London.)

TABLE III

ANNUAL PRODUCTION OF MINERALS IN EGYPT, 1938–1949

(In metric tons)

	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949
Crude oil	230,000	670,000	930,000	1,210,000	1,170,000	1,280,000	1,350,000	1,340,000	1,280,000	1,340,000	1,890,000	2,300,000[1]
Manganese	153,112	119,882	64,912	2,175	8,169	7,079	30	47	26	29	60,000	139,000
Phosphates	458,404	548,538	183,464	111,708	327,470	315,566	318,186	349,374	294,047	371,227	377,000	350,480[2]
Iron oxides	714	719	2,633	2,893	7,100	4,666	2,723	4,056	2,477	2,211	2,050	798
Talc	1,251	833	2,212	5,229	1,874	2,054	4,265	3,868	4,760	4,660	5,210	5,063
Gold (ozs.)	2,162	3,877	7,344	2,868	1,868	890	1,036	3,014	2,793	2,090	x	x
Natron	5,000	3,750	3,500	6,200	9,000	7,960	7,000	6,700	7,850	5,124	3,500	x
Common salt	285,000	442,000	206,000	155,000	101,000	107,000	199,000	255,000	227,000	623,000	127,000	350,000
Chromium	x	x	x	x	307	910	150	150	x	267	191	50
Asbestos	x	x	x	x	20	7	240	85	66	1,017	1,625	117
Kaolin	x	x	x	130	355	539	693	512	219	153	147	x

Sources: *Statistical Yearbook, United Nation, 1948*, New York, 1949; Figures of crude oil and natural gasoline production supplied by Shell Petroleum Co., Ltd.

x = not available.

[1] Crude oil production, 1950, 2,590,000 met. tons.

[2] Phosphate production, 1950, 397,000 met. tons.

Other Industries

The manufacture of tobacco and cigarettes is one of Egypt's noted industries and, although only a small employer of labor, ranks as Egypt's third most important industry by value of production. The industry relies entirely upon imported Balkan and Virginian tobacco, since for revenue purposes tobacco cultivation in Egypt is prohibited. The annual output of the soap industry is now 60,000 tons (45,000 tons in 1938) and covers all Egypt's domestic soap requirements and provides toilet soaps which compare favorably with those previously imported. Since 1940 the industry has relied mainly upon cottonseed oil and locally produced caustic soda. The glass industry has grown substantially and supplies the bulk of the home market with tumblers, electric globes, and bottles for the growing fruit-juice, chemical, and pharmaceutical trades (Fig. 8). A number of Czechoslovak glass specialists are employed, and machinery for the production of sheet glass is being installed. The leather industry now meets practically all the local requirements for footwear, saddlery, handbags, and suitcases. Other consumer goods now manufactured include cooking and heating stoves, torch batteries, electric bulbs, cigarette lighters, cooking utensils, wrapping papers, and cardboards (mainly from rice straw).

MINING AND QUARRYING

The mineral resources of Egypt are still comparatively little exploited. The main reasons for this are:

1. The paucity of knowledge of the country's mineral wealth.
2. The inaccessible nature of many of the known deposits.
3. The high cost of transportation, rendering the working of many known deposits uneconomic.
4. The shortage of engineers, foremen, and miners; and the lack of amenities for labor in many of the mining camps, where all necessities, including food and water, have to be imported.
5. The general reluctance to sink capital into such highly speculative ventures.

Because of the poverty of good communications across the Eastern Desert, mining is confined mainly to the Nile Valley and Red Sea coast, and the high cost of transportation (often several

times that of extraction) is the most hampering economic factor which the industry must face. Table III reveals the varied nature of the minerals worked and also, for the most part, their very small production.

It is in the *oil* industry that the most rapid developments have taken place during the last decade (see Fig. 2), essentially due to political and economic problems of the war period. The main oil wells lie in the Eastern Desert near the Red Sea littoral, at Ras Gharib and Hurghada, while large new wells have been opened since 1946 in the Sinai Peninsula at Sudr and Asl, 40 miles southeast of Suez (where the refineries are situated). Government restrictions on oil exploration have been lifted recently and oil prospecting and exploratory drillings are now being carried out in the Eastern and Western Deserts as well as in the Sinai Peninsula.

The *phosphates* of the Red Sea littoral (mined at Quseir and Safaga), and of the Upper Nile Valley (mined at Siba'iya), provide a valuable mineral export. Production of phosphate rock approaches 400,000 tons per annum, and overseas markets (formerly Japan) have been found in Italy, Spain and South Africa. The workings at Siba'iya are limited in scale at the moment owing to the shortage of railway wagons. On this site is a plant manufacturing 15,000–20,000 tons of superphosphates each year for the home market. *Manganese* ore—from the Abu Zeneima district on the Red Sea coast of the Sinai Peninsula—is once again providing a major mineral export. The quality of the ore is low and there is the additional burden of Suez Canal dues, but the cessation of Caucasian supplies and the rearmament and stock-piling programs of the West have forced up demand and prices, rendering remunerative production that was once marginal. During and immediately after the war extraction of manganese ore virtually ceased.

FIG. 8. The new Sayyid Yassin glass factory erected beside the Nile in Shubra, a suburb of Cairo. The Egyptian glass industry has developed markedly since 1940 and a wide range of glass products is now made. (Courtesy of the Egyptian Education Bureau, London.)

Egyptian *limestone* is not only a building stone of paramount significance, but forms the basis of the cement industry. Together these two building materials are of prime importance in the building of Egyptian towns and cities. The annual output of cement in pre-war years was about 300,000 tons, but steady expansion has occurred since 1939 and production in 1950 was just over 1 million tons. Imports have entirely ceased. The main cement plants are located at Tourah and Helwan, where the limestone Mokattam Hills are only eight miles from Cairo, and where good and relatively cheap transport of fuel and gypsum is possible.

Egypt's largest and most significant mineral deposits have yet to be worked. They are the vast *iron oxide* deposits discovered 50 kms. east of Aswan in 1937. The deposits (variously estimated between 300 and 500 million tons) lie in a field covering an area of approximately 1,200 sq. kms. The iron content is high, averaging 53 per cent, and the ores are free from sulphur. They lie

at a shallow depth and can be worked easily. Exploitation has been hampered by lack of fuel, but with the adjacent Aswan Dam hydroelectric project now under construction the utilization of this considerable basic mineral wealth will not long be delayed. It was from iron oxides near Aswan that the Ancient Egyptians prepared their red and yellow paints; since 1917 these ancient workings have been reopened and there has been a small annual extraction of the oxides for the same purpose.

POSTWAR DEVELOPMENT

The uncertainties of postwar years and the return to competitive conditions threatened a serious industrial slump. This has been partially fended off by government support, involving the strengthening of the tariff measures against imported manufactured goods and the relaxation of duties on imported machinery. In this way the Government seeks to shield home industry for the time being, to allow prices and quality to adjust themselves to the level of competitors; in so doing it is possible that a great deal of uneconomic wartime production is being perpetuated at the expense of the consumer. Reports suggest that urban unemployment has increased markedly since the war ended (the lack of unemployment assistance or social services generally preclude statistics on this point), and thus the Government's strengthening of the tariff policy in a sense may be regarded as a social measure to keep workers in employment.

Responsible Egyptian opinion is that with a rising population and a limited, densely populated, area available for cultivation, Egypt cannot expect an improved standard of living without increasing industrialization. Already since the war many new industrial projects have been begun, the main fields of activity lying with textiles, artificial fertilizers, plastics, chemicals, iron and steel, and the expansion of Egyptian-owned marine shipping. However, the greatest project of all, and one which will do more than any other to make possible yet further industrialization, is the scheme for generating electricity from the Nile, in the first place at the Aswan Dam.

Aswan Dam Hydroelectric Scheme and New Industries

Wartime industrial developments and the urgent need for cheap power to maintain and expand these ventures have made this great electrification project (first mooted in 1912) an urgent necessity. The scheme was endorsed by an International Committee of Experts in May, 1947, and the work on the construction of the power house began in the following year. There have been various delays, and the tentative date for the completion of the project is now 1953. The head of water supported by the Dam varies with the Nile regime; thus the output of power will also vary with the state of the river. During the months July to October, when the Nile is in flood, all the sluices of the Dam are opened and the head of water is at its lowest. At this period power output will fall to a minimum of 86,000 kw., and a maximum of 260,000 kw. will be attained when the Dam is completely filled in December and January. In other words, "firm" or constant power from the project will be 86,000 kw. with substantial seasonal additions for 8 months of the year, attaining for a few weeks an output as high as 260,000 kw. The total energy available will be nearly 1,800,000,000 kwh[4].

The high proportion of seasonal power

[4] "Report on Economic Utilisation of Energy Available from the Aswan Dam and Nile Barrages Hydro-electric Schemes," Cairo, Govt. Press, 1947.

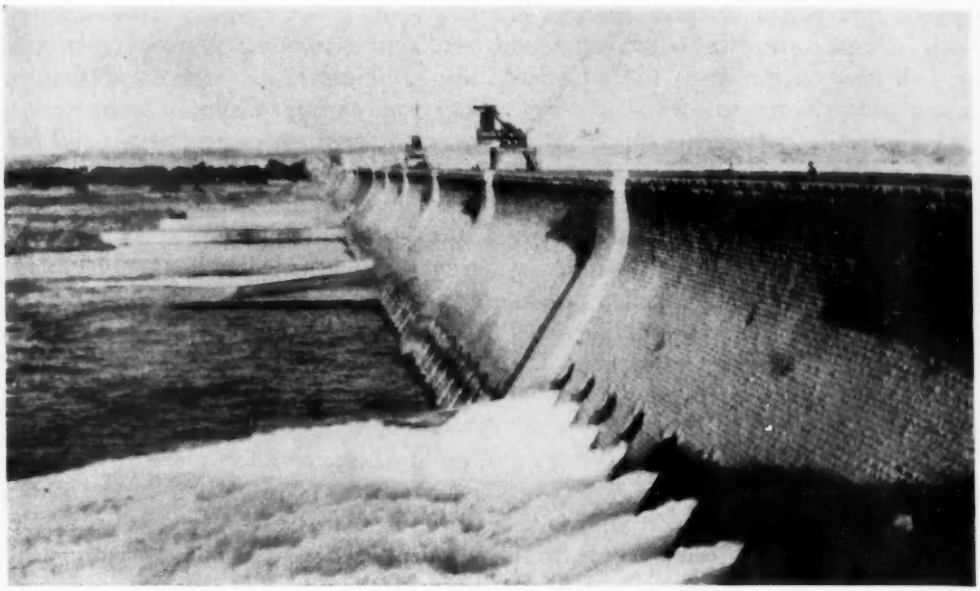

FIG. 9. The Aswan Dam, 2,141 meters long and containing 180 sluices, stores the bulk of the water needed for summer irrigation in Egypt. Adapting the dam for H.E.P. purposes is difficult, for its safety must not be impaired. (Courtesy of the Egyptian Education Bureau, London.)

generated is a disadvantage in that its market is limited to industries whose output can be stopped completely or severely curtailed during the flood season. Because of this intermittent working such industries can only afford to pay very low rates for power. The firm power, being available whenever required, can be sold to markets needing continuity of electric supply and consequently can command a much higher price. The disproportion between the firm and seasonal power has been one reason for the shelving of the original plan to convey part of the power output by a high voltage grid system to link with the thermal-electric grid of the Delta.[5] Present plans are for the firm power to be used mainly for pump irrigation in Qena province and for general, industrial and municipal uses in the Aswan-Assiut region. The bulk of the power generated, being seasonal, is to be used near Aswan in what are to be two of the largest of Egypt's industrial enterprises—an electro-chemical plant for the manufacture of nitrogenous fertilizer, and an electrometallurgical industry based upon the rich iron-ore deposits in the vicinity of Aswan. In both cases production will stop or be greatly reduced during the flood season. Once the Aswan scheme has come to fruition further electrification projects based upon the other Nile barrages are to be undertaken.

Under the perennial system of irrigation Egyptian land is denied most of the annual rejuvenating mantle of Nile alluvium, and is under almost constant cultivation. Soil exhaustion is thus a very real problem, and Egyptian agriculture has come to rely heavily upon imported artificial fertilizer. Before the war Egypt imported half a million tons of nitrates annually, costing about £3 million; by 1949 her imports had again reached that tonnage but at much higher cost, for the price of nitrates has

[5] A. Dorra: "L'Aménagement hydroélectrique du Barrage d'Assouan," *Egypte Contemporaine*, Vol. XXIX, 1938, p. 620.

trebled since 1938. The proposed new plant, to be at Nag' Hammadi, will use local limestone and employ two-thirds of the seasonal power output of Aswan to fix atmospheric nitrogen. It is planned to produce 320,000 tons of calcium nitrate each year, or about half Egypt's present requirements. It is estimated that the fertilizer can be produced 50 per cent cheaper than that imported. Demand for nitrogenous fertilizer is expected to reach 800,000 tons in the near future.[6]

The iron and steel project, although of smaller dimensions, in one respect is even more ambitious, since it represents a type of industry mainly outside the experience of Egyptian technicians and workers. The widespread deposits of rich nonsulphurous hematite ore, offering easy conditions of extraction, lie barely 30 miles from the future Aswan power station. Although the final details of the scheme have yet to be worked out, it has been decided to set up an iron and steel plant beside the Nile near Aswan, to capitalize advantages of proximity to power, to the ore field, and river transport for limestone from Esna or Nag' Hammadi. Water transport will also facilitate the import of the small quantities of coke needed for reducing the ore in the electrical smelting process. French experts from the famous Schneider-Creusot firms are in Egypt advising on this iron and steel project and already satisfactory tests upon the quality and properties of steel made from the Aswan ores have been carried out. The proposed steel production will be at the modest figure of 91,000 tons per annum.

Postwar Mining

Already the postwar years reveal a considerable interest in the development of the Egyptian mining industry. Mining provides an extreme case of the control of location by the raw material; the choice of deposits worked depends mainly upon accessibility in relation to transport availability and costs, and labor supply. This accounts for the concentration of most of the Egyptian mining industry upon the Red Sea littoral and Sinai. The Western and Libyan Deserts are untouched and still await a detailed geological survey, while many known deposits in the Eastern Desert and Red Sea region cannot be worked owing to inaccessibility and lack of drinking water.

The first step now being taken towards a more coherent development of mineral resources is the systematic geological mapping and prospecting of the country. In the second place it is realized that future development will depend upon the provision of good means of transportation, especially across the Eastern Desert from the Nile Valley to the Red Sea. Steps are being taken to do this, mainly in the first instance by restoring old roads, such as that from Edfu to Mersa Al-Alam on the Red Sea coast (this has made possible the working of extensive asbestos deposits since 1947). Finally, the training of mining engineers and geologists has been begun at Fuad University, Cairo, in a Department of Mining established in 1947.

The Eastern Desert consists largely of igneous rocks much faulted and traversed by dikes, highly favorable to mineralization. A great deal of the area has yet to be surveyed, but in addition to minerals already worked deposits of zinc, copper, nickel, wolfram, tin, ilmenite (titanium), and fluospar are known. It may be that many of these deposits will prove to be too small for economic working, but experts in Egypt are optimistic that with the application

[6] J. Anhoury: "Les engrais chimiques et leur rôle dans l'Economie de l'Egypte," *Egypte Contemporaine*, Vol. XXXIII, 1942, pp. 29–47.

of Aswan power to better communications and to facilitate the supply of drinking water to the mining camps, a notable expansion of the Eastern Desert mining industry will be possible. Certainly world prices today make it worth while for otherwise marginal deposits to be exploited, and the intense spirit of nationalism in the country is a further less calculable factor which may stimulate such activities.

EFFICIENCY OF EGYPTIAN INDUSTRY

One method of judging the overall efficiency of competitive industries is on a basis of cost relationships. Broadly speaking the industry which can produce its goods most cheaply is likely to be most efficient in its general organization and use of raw materials, fuel, labor, etc. In applying any such test to the bulk of Egyptian industry one quickly discovers the very great influence exerted by the tariff policy, for the majority of Egyptian-made commodities are marketed at far higher prices than world prices. Sugar, for example, sells at twice the open-market price, and this imposition is passed on to industries using sugar as a raw material. Textiles also sell above general world prices due in part to the 100 per cent duty levied on raw cotton imports into Egypt. This effectively keeps out the lower quality Indian and East African cottons, so that even the cheapest garments must be made of cloth woven from expensive Egyptian cotton.

The disparity between home and world prices does not necessarily represent profit to the Egyptian industrialist, although profits are certainly high (1928–39 net profits averaged 13 per cent of share capital[7]), for generally Egyptian production costs are markedly higher than costs of similar production in other countries. In fact, the tariff permits high-cost noncompetitive production. The details afforded by the 1944 Census of Industrial Production (the first of its kind in Egypt) permit an analysis of manufacturing costs, and the division of industrial expenses for some of the major industries relying mainly upon indigenous raw materials is set out in Table IV. It will be seen that the principal item of cost, averaging 80 per cent of all industrial expenses, relates to the provision of raw materials. Salaries and wages account for only 12.6 per cent, and fuel for but 5.6 per cent of industrial costs.

The high cost to industry of home-produced raw materials can be attributed to many varying factors, chief among them being the poor quality and low productivity of Egyptian labor; manual rather than mechanical methods of extraction or production; high transportation costs due mainly to the virtual monopoly held by the State Railways; and the wasteful and uneconomic use of the raw materials within the factories. The high proportion of the workshop type of industrial establishment making little use of machinery is a further factor tending to high-cost production. Another serious problem to be overcome if greater efficiency is to be attained is that of uneconomic staffing; far too heavy a proportion of clerical, technical, and administrative staff are carried as compared with corresponding industries abroad, and the cost of management is unduly high. To a great extent this is attributable to widespread nepotism and favoritism.[8]

Egyptian industry, then, is perpetuated in its present form mainly as a result of government tariff support, and

[7] C. Issawi: "Egypt: An Economic and Social Analysis," London, 1947, p. 91.

[8] A. B. Mountjoy: "Problems of Industrialization: An Egyptian Example," *Indian Geographical Society Souvenir Volume*, Madras, 1952.

its value in that form to the Egyptian economy as a whole is extremely debatable. Its presence is a measure of insurance against further periods of chronic shortage should war come again; it may add to Egyptian prestige within the Arab world; it forms a tangible and satisfying factor resulting from, and stimulated by, the spirit of nationalism so ardently expressed by the articulate few forming Egyptian "public opinion."

TABLE IV

DIVISION OF INDUSTRIAL EXPENSES, 1944

Industry	*Salaries and wages*	*Raw materials*	*Fuel*	*Rent and depreciation*	*Total*
Spinning and weaving	20.6	65.2	10.9	3.3	100
Food industries	9.4	83.7	5.4	1.5	100
Leather processing	26.8	70.6	0.9	1.7	100
Extraction of raw minerals	14.9	76.3	4.0	4.8	100
Chemical industry	9.3	82.1	6.5	2.1	100
Glass making	34.9	42.4	15.6	7.1	100
Paper manufacture	23.8	66.9	4.4	4.9	100
All manufactures	12.6	79.8	5.6	2.0	100

Prepared from Tables V and VI, *Census of Industrial Production, 1944*, Cairo, 1947.

It is claimed to be of value as a means of absorbing surplus population and of raising the standard of living, but these claims are scarcely borne out by the facts. Twenty years after protection was first granted the number employed directly in manufacturing industry has risen from about 250,000 to no more than 400,000. If ancillary services, repairing establishments, mining, and building activities are included the figure rises from 620,000 to about 900,000. In this same period the population of Egypt has risen by well over 5 millions; at present the annual increment to Egypt's 20 million population is of the order of 300,000. From these figures it becomes obvious that industrial activities have played but a negligible part in the absorption of this population increase.

The claim that the standard of living is being raised by the development of industry when applied to the population generally is also very doubtful. In the first place industry affects only a minority of the population, and thanks to its costly production fails to form an adequate bridge over the tremendous gulf separating the incomes of the rich and the poor. The very fact that prices are so high effectively serves to limit the market. So far as possible the poor do without, and continue to live as their fathers before them.

Thus it would seem that despite appreciable development over the past two decades Egyptian industry as yet fails to contribute really effectively to the country's economy; particularly does it fail in attaining those very objects for which it is ostensibly fostered. The chief argument against subsidizing an industrial enterprise is that it will be tempted to recline comfortably as on a feather bed, instead of striving to master its problems by making itself more efficient. This has occurred in Egypt, where over a period of 20 years the tariff rates have gone up rather than down. In a country exhibiting such widespread poverty it is an unnecessary and costly luxury to perpetuate uneconomic production (paid for by the consumer) on the score of national self-sufficiency. In the long run if industry is to benefit a nation it must produce low-cost goods and be competitive with

foreign goods. If it cannot do so it is questionable whether such activities represent the best use of both natural and human resources.

Egypt undoubtedly has a varied wealth of natural and derived raw materials suitable for industrial processing which, given efficient industrial organization, would permit competitive production: textile raw materials; agricultural produce for food industries; hides and skins for leatherworking; artificial fertilizers; and certain mineral extractions would seem most suitable. Both oil and hydroelectric power are, or will soon be, available, and apparently there is no lack of capital for industrial investment. There is an abundance of relatively cheap but mainly unskilled and unorganized labor. The major limiting factors lie in the narrowness of the home market, low productivity per head of Egyptian workers, the lack of trained managerial and administrative personnel, and, finally, the disincentive to economic efficiency of the "feather bed" tariff policy.

Industrial expansion in Egypt will continue to be circumscribed so long as its markets are so narrowly limited. The possibility of widening markets by exporting manufactured goods is slight, for not only are present prices of finished goods noncompetitive, but the quality is usually poorer than that of established foreign products, packing and finish is generally inferior, and there is considerable sales resistance against goods coming from countries where hygienic standards are low. An expansion of certain mineral exports may be possible as the mining industry develops, particularly with regard to oil products, phosphates, manganese, and iron ores.

The one foreign market for Egyptian manufactured goods that may develop emanated during the war years when, thanks to the Middle East Supply Centre's encouragement and shipping difficulties, a greater volume of trade passed between the Middle East states. These states are mainly agricultural and have relatively low purchasing power. In the past agricultural Egypt has had little to offer them, but today with her growing industries the situation is changing. Egypt's trade with the Sudan is increasing, the principal commodities concerned being boots and shoes, cigarettes, sweets, sugar, soap, and textiles. The war with Israel has revealed the weaknesses of the Arab League, but it has also fanned pan-Arab sentiments, and Egypt is in a favorable position to gain commercially from further developments in this direction. However, Egypt must realize the challenge that now faces her from the virile new state of Israel. It can be assumed that industrial development will not be neglected by this new state, where business acumen, a growing pool of skilled labor (including a large element versed in the industrial tradition of the West), available capital, and the necessity of supporting a growing population on a none too generously endowed land are decisive factors.

THE PHYSICAL BASIS OF AGRICULTURE IN BRITISH COLUMBIA

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PHYSIOGRAPHY, climate, and soil impose significant limitations on the location, nature, and possible expansion of agriculture in British Columbia. Economic and cultural factors also influence the agriculture of the area profoundly, but this paper is an attempt to analyze only the physical basis of the industry.

With the exception of the northeastern sector of the Province which is a part of the Great Plains, British Columbia lies within the Cordillera physiographic division (Fig. 1). Land topographically suitable for farming is found only in valleys, in relatively low intermountain basins, and on the plains in the northeast. It is remarkably diffuse and limited in amount.[1] The northern half of the Province is climatically unsuitable for intensive farming because of the frequency of summer frosts. In the southern half, some arable areas are too wet for many plants, others too dry[2] (Fig. 2). Furthermore large areas of level to rolling land contain soils that are heavily leached, acidic, and poor in structure. Other sections have stony soils.[3]

[1] V. C. Brink and L. Farstad: "The Physiography of the Agricultural Areas of British Columbia," *Scientific Agr.*, Vol. 29, 1949, pp. 273–301.

[2] D. P. Kerr: "The Regional Climatology of Southern British Columbia," unpublished Ph.D. thesis, University of Toronto, 1950.

[3] C. A. Rowles: "Soil Outline of British Columbia," in Transactions of the Second Resources Conference of British Columbia, Victoria, B. C., 1949, pp. 7–34.

All in all, slightly over 4 million acres of the Province, or about 2 per cent of the total land surface is occupied for agricultural use and just over 1 million acres are cultivated.[4] The unimproved land is used principally for cattle and sheep ranching.

Agricultural regions *per se* do not exist in British Columbia, but agricultural districts, of which there are four, are recognizable (Fig. 3): the Coastal Valleys, the Southern Interior Valleys, the Nechako Pioneer Farming Belt, and the Peace River Bloc. The Coastal Valleys have approximately 370,000 acres of cultivated land of which approximately 95 per cent are found in the Lower Fraser Valley and the East Coast Lowlands of Vancouver Island within the Southern Coastal Trench. Of the 420,000 acres of improved land in the Southern Interior Valleys, over 160,000 acres occur in the Okanagan Trench. There are about 90,000 acres under cultivation in the Nechako district and 200,000 in the Peace River Bloc.

Agriculture in the Coastal Valleys

The Western Mountainous Belt, which includes the Insular Mountains, the Coastal Trench, and the Coast-Cascade Mountains (Fig. 1), contains a few pockets of land topographically, climatically, and pedologically suitable

[4] *Ibid.*, p. 62.

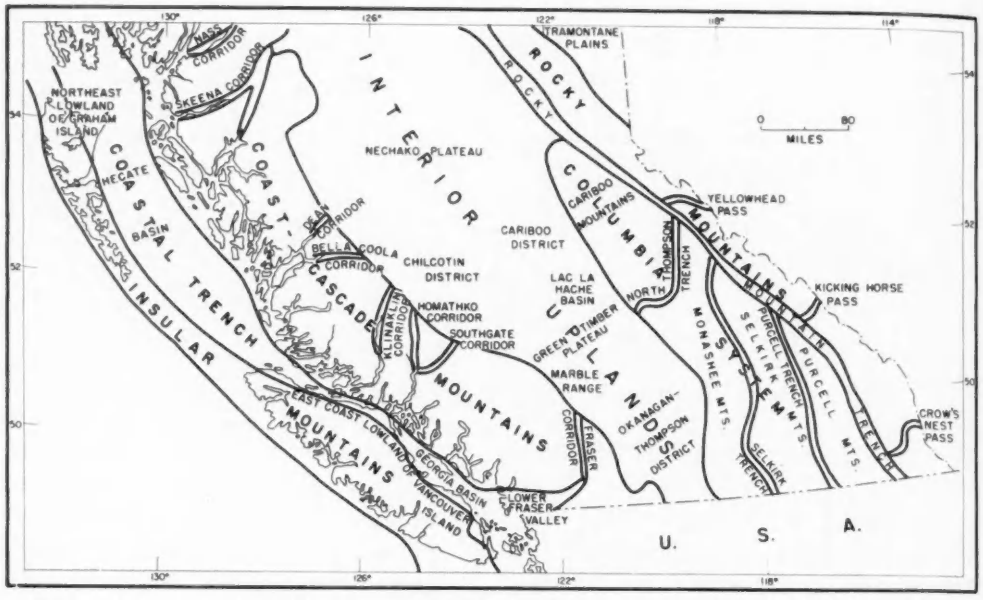


FIG. 1. Physiographic divisions of southern British Columbia. Southern British Columbia comprises two major physiographic divisions: the Cordillera and the Great Plains or Tramontane. The former includes three systems: the Western Mountainous made up of the Insular Mountains, the Coastal Trench, and the Coast-Cascade Mountains; the Interior Uplands; the Eastern Mountainous, comprising the Columbia group of mountains and the Rocky Mountains partitioned by the Rocky Mountain Trench. The trenches, intermountain basins, and plains are emphasized because of their agricultural significance.

for agriculture. The largest and economically the most important are the Lower Fraser Valley and the East Coast Lowlands of Vancouver Island (including the Gulf Islands). Other sections largely undeveloped are: Alberni Basin, Graham Island Plain, Tofino Plain, Terrace Valley, Pemberton Meadows, and small deltas at the mouths of rivers flowing transverse to the Coast Range such as the Bella Coola and the Squamish (Fig. 3).

(a). The Lower Fraser Valley is triangular in shape, broadening toward the west between the Coast and Cascade Mountains which rise sharply to over 6000 feet on the northern and southern margins respectively (Fig. 4). Within the Valley two distinct physiographic types obtain: the lowland, principally under 50 feet, and the upland, averaging 300 feet but extending to a maximum of 1000 feet at the edge of the mountains. The lowland areas include Lulu Island, Langley Prairie, Pitt Valley, and Ladner District in the west and Sumas Prairie, Agassiz, and Harrison Districts in the east. They have a typically low and flat surface. The land must be dyked against annual flooding and, because of poor natural drainage, pumping stations and drainage canals are necessary. Many soils are Recent alluvial and being inherently fertile are highly prized for agricultural use. Ground water soils have significant distributions. They have a high organic matter content and fine texture and are intensively utilized for farming.

Upland sections present a rolling to hilly surface. Soils have developed on various glacial materials ranging from ground moraine to stratified sands. Because of the typical porous nature of the sub-stratum and the cool, humid climate, they are well-leached, acidic

podsols.[5] Such soils support mainly a second growth forest of alder and maple, and farming is not as prosperous or as widespread as on the lowland soils.

Climate favors the specialized type of agriculture. Average annual precipitation throughout the Valley varies from 35 inches in the southwestern section to over 60 inches in the northern and eastern portions and increases to over 100 inches along the mountain slopes. Fully 75 per cent of the rain falls in the period from October to March (inclusive); occasional summers are very dry but the average water deficiency according to the Thornthwaite[7] formula is 6.5 inches at White Rock and barely 1 inch at Stave Falls. From time to time, pastures dry out during a prolonged drought, but, in the main, irrigation is not necessary in the Valley. Average temperatures in the cool season are above freezing and consequently winter pasturing of dairy cattle is possible.

The production of whole milk for the Vancouver market is the leading industry.[7] Approximately 40 per cent of the farm land is in either natural or controlled pasture but about 34 per cent is used for the growing of grain, most of which is fed to dairy cattle and poultry. Egg production in the area is consistently high throughout the year, principally because of the lack of temperature extremes. Vegetables and small fruits are raised mainly on the Lowland soils, orchard fruits on the Upland. Temperatures rarely fall below 0 degrees F. in the Valley in winter thus minimizing the danger of winter killing to sensitive orchard fruits.

(b). The East Coast Lowlands of Vancouver Island and the Gulf Islands contain approximately 80,000 acres of cultivated land.[8] The most productive farm lands have a discontinuous distribution and are associated with postglacial deltas and lake bottoms. Such land forms are separated by low monadnocks or eastward extending crystalline spurs of the Vancouver Island Mountains.

The southeastern littoral of Vancouver Island has the lowest rainfall on the British Columbia Coast. It is

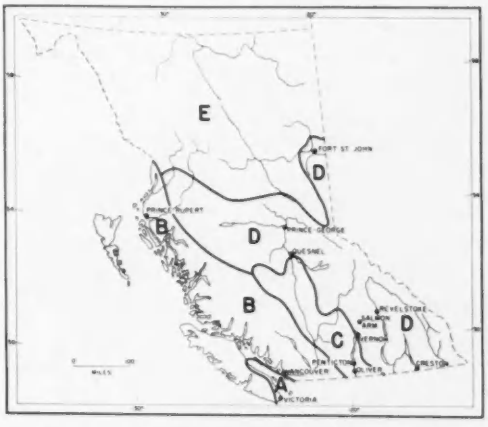


FIG. 2. Climatic regions of British Columbia. The climate of British Columbia is very diversified: the Coast is the most humid area in Canada, the Interior one of the driest. Numerous micro climates appear because of the mountainous terrain. However, the following regional division is offered:

A. The Southern Coastal Trench has dry cool summers, humid mild winters.

B. The Coast has a fully developed maritime climate characterized by mild exceedingly wet winters and cool moderately wet foggy summers.

C. The Southern Interior Uplands have less than 15 inches of rain annually, average temperatures over 65° F. in summer and over 20° F. in winter.

D. The Columbia-Nechako-Peace area has cold, snowy winters and cool, moderately humid summers.

E. Northern British Columbia has a long cold winter and a short cool summer in which frost may be expected.

[5] C. C. Kelley and R. H. Spilsbury: "Soil Survey of the Lower Fraser Valley," Dom. Dept. of Agr., Tech. Bull., No. 20, Ottawa, 1939.

[6] C. W. Thornthwaite: "An Approach Toward a Rational Classification of Climate," *Geogr. Rev.*, Vol. 38, 1948, pp. 55–94.

[7] S. English: "Problems of a Specialized Area" in H. A. Innis ed., The Dairy Industry of Canada, Ryerson Press, Toronto, 1937, pp. 213–48.

[8] R. H. Spilsbury: "Land Utilization on Vancouver Island," *Forestry Chronicle*, Vol. 19, 1943, pp. 160–168.

sheltered by the Olympic and Vancouver Island Mountains from prevailing southwesterlies which transport moist, unstable Pacific air on shore during most of the year. Average annual rainfall exceeds 100 inches on the exposed southwestern coast of Vancouver Island but ranges between 27 inches at Victoria and 40 inches at Campbell River on the eastern. The summer is normally dry with a water deficiency as high as 10 inches at Victoria.[9] Temperatures are similar to those in the Lower Fraser Valley.

Soils are complex on the East Coast of Vancouver Island and on the Gulf Islands. Pockets of alluvial soil are scattered through the region, but the bulk of soils are brown to reddish brown in color, heavily leached and acidic. On the whole, such soils are low in basic elements and fertilizer must be applied to secure moderate yields.

Dairying, poultry raising, and cultivation of vegetables and fruits characterize the agriculture of the area. The growing of spring flowers, such as daffodils and narcissi, for the distant central and eastern Canadian market in late March and early April is an economic expression of the early spring season in the Victoria region.

(c). The remaining arable pockets within the Western Cordillera comprise less than 20,000 acres of improved farm land. Such agricultural communities are widely scattered on the few narrow discontinuous coastal plains or ledges, lowland deltas at fiord heads, and small intermountain basins. Most of the land is truly mountainous and is incapable of being settled. The entire area is perhumid[10] and has cool summers and average winter temperatures slightly above freezing in lowland portions. Where soils have formed they are excessively leached, acidic and very low in basic elements.

Practically all farms are subsistence and many are worked on a part-time basis. Fishing and forest industries supplement the meager farm incomes of most settlers. The raising of dairy and beef cattle and cultivation of root crops such as potatoes characterize the agriculture.

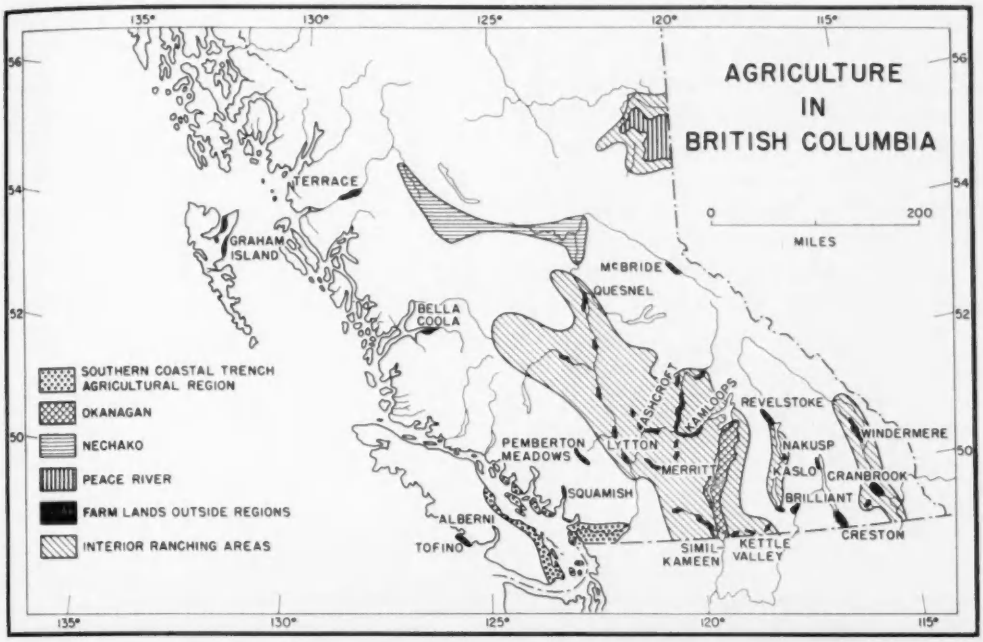
A typical development is that in the Bella Coola Valley located at the head of North Bentinck Arm at approximately latitude 52° 20′ north and longitude 126° 40′ west (Fig. 3). This U-shaped valley is drained by the Bella Coola River which has formed a delta at its mouth and a narrow alluvial flood plain in its lower course. Of the 18,000 acres of occupied farm land in the Valley only 5 per cent is improved. Approximately 40 per cent is in woodland, 30 per cent in natural hay and 23 per cent is marsh and waste. Only 3.5 per cent of the total farm area is planted in crops, of which potatoes are the most significant. Beef cattle are grazed throughout the area and their sale constitutes the main farm income.

Physical factors limit agricultural prosperity and expansion. The arable area is small and isolated. Fertile alluvial soils comprise only a small portion of the Valley, and such lowland sections are subject to periodic flooding especially in late spring. The forest is dense and difficult to clear.[11]

The largest area, topographically suitable for farming on the Coast is the Graham Island Coastal Plain (Fig. 1) where only approximately 1000 acres are being farmed at present. Whitford

[9] Thornthwaite, *op. cit.*
[10] *Ibid.*

[11] Probably the most restrictive factor is the lack of markets for agricultural produce. Population is sparse and diffuse along the Coast, and the Vancouver market is too distant to be effectively entered.



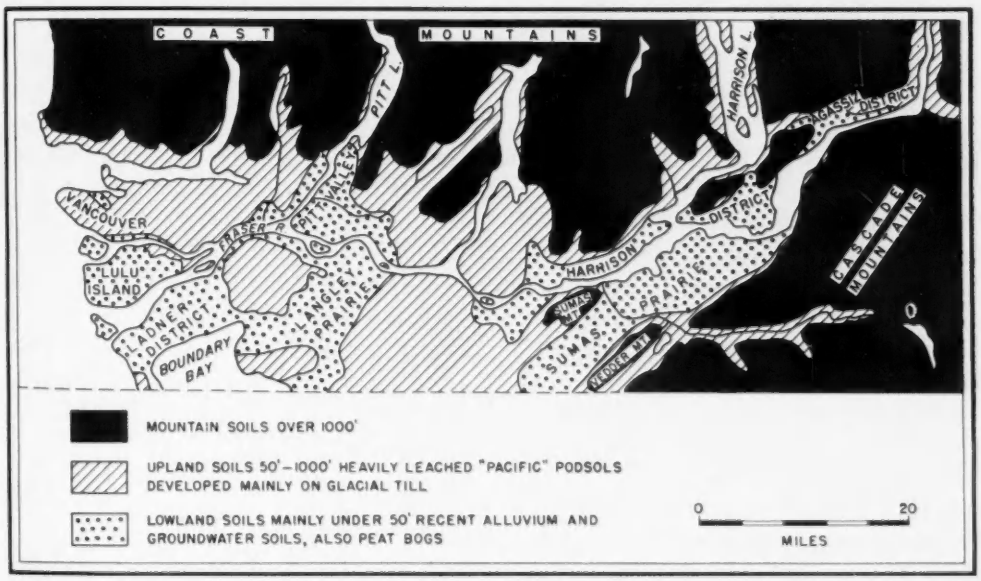


FIG. 3. The location of agriculture in British Columbia. No commercial agriculture is carried on in northern British Columbia. (Reprinted with permission of J. M. Dent Co.)

FIG. 4. The distribution of lowland, upland, and mountain soils in the Lower Fraser Valley.

and Craig[12] from a general reconnaissance of the area estimated that 825,000 acres could be used for agriculture. Such an estimate is probably too optimistic, and a detailed survey of the physical qualities of this area is necessary to forecast its capabilities.

The Plain is low and gently rolling and occupies the northeastern third of the Island. A few residual volcanic

[12] H. N. Whitford and R. D. Craig: "Forests in British Columbia," Commission of Conservation, Ottawa, 1917.

hills rise to just over 400 feet, but, on the whole, the area is under 200 feet. Patches of dense forest comprising principally Sitka spruce and Western hemlock alternate with damp meadows. Moss and a tangled mass of decaying vegetation as much as two feet thick cover most of the area. Such a condition has discouraged clearing although Recent alluvial soils await the settler in the shallow valleys. Admittedly proper draining and dyking of the lowland soils would be expensive. The growing season is long but cool and foggy. There is no deficiency of moisture and pasture grasses, root crops, and small fruits should thrive.[13]

AGRICULTURE IN THE SOUTHERN INTERIOR VALLEYS

Agriculture comprises two major types in the Southern Interior: cultivation of fruits and vegetables, largely through irrigation, and wheat in the narrow, deep valleys; and the raising of cattle and sheep in the valleys in winter and along the upland slopes in spring, summer, and early autumn. Physiography imposes the most severe restrictions on the industry. In the western portion of the Interior, the Interior Uplands physiographic division, rivers are entrenched on the average 3500 feet below the summit level. Their valleys are narrow and steep-sided, offering arable land only in the floor and along the terraces. To the east, in the Eastern Cordillera, faulted depressed trenches have been endowed with only fragments of level land. Such low-lying strips are partitioned by high, rugged mountains in the eastern sections, and by severely eroded uplands in the west. They constitute the farming districts of the southern Interior. The Okanagan Valley is the most highly developed; the Middle-Thompson, Nicola, Middle-Fraser, Lower North Thompson, and Kettle Valleys support farming communities in the Interior Uplands. Patches of farm land are found in the Selkirk, Purcell, and Rocky Mountain Trenches of the Eastern Cordillera. All in all, over 400,000 acres are under cultivation.

The majority of the Southern Interior Valleys parallel the northwesterly trend of topography in British Columbia, and, consequently, lie sheltered from the prevailing southwesterly flow of air. As a result, they are dry, receiving in most sections less than 15 inches of rain annually. Availability of irrigation water is an important factor in controlling development of farming in the region.

(a). The Okanagan is the most intensively cultivated and most prosperous valley in the Interior. It is a region of orchard fruit specialties, market gardening, and dairying.

The depression proper (Fig. 5) extends for almost 140 miles in a northerly direction from the American border to Shuswap Lake. It averages two miles in width in the south but broadens to over 12 miles in the northern portions. A large part of the trench is occupied by lakes. The lower slopes of the valley side are characteristically arranged in terraces, the highest of which is about 2000 feet. Such land forms, composed of laminated silt,[14] are of great agricultural value. Upwards to a maximum of 6000 feet the valley sides have moderate to steep slopes. A few small lakes in the neighboring hills are used as reservoirs for irrigation in the lowland.

The horizontal and vertical distribu-

[13] See "Canada's New Northwest," section on Agriculture, North Pacific Planning Project, Ottawa, 1947, p. 47. Large scale settlement has been restricted because much of the land has been taken up under timber leases, no market exists for agricultural produce and the area is, to a large extent, isolated.

[14] Brink and Farstad, *op. cit.*

TABLE I

CLIMATIC DATA FOR SELECTED STATIONS IN BRITISH COLUMBIA*

Station	*Height in Feet Above M.S.L.*	*Mean Annual Temperature*	*Mean Temperature (June, July, August)*	*Frost-free Period*[a]	*Mean Annual Precipitation*	*Mean Precipitation (June, July, August)*	*Average Annual Moisture Deficiency in Inches*[b]	*Moisture Index*[c]	*Lowest Temperature Ever Recorded in July or August*	*Lowest Temperature Ever Recorded*
Victoria	228	50	59	275	27.1	1.8	10.0	23.0	37	− 2
Vancouver	10	49	62	219	57.3	5.4	3.6	131.0	41	0
Prince Rupert	170	46	56	198	95.1	13.9	0	312.0	34	− 6
Oliver	995	50	70	152	9.4	2.3	19.0	−41.2	38	−20
Penticton	1,200	48	66	149	10.8	2.8	14.2	−34.5	31	−16
Vernon	1,383	46	66	152	15.3	3.8	12.3	−18.3	29	−30
Salmon Arm	1,600	46	65	153	19.0	4.0	10.2	2.0	32	−31
Quesnel	1,750	40	60	102	15.7	5.0	8.1	−12.1	29	−50
Creston	1,990	44	63	120	18.6	3.5	10.0	− 0.6	31	−27
Revelstoke	1,494	43	62	126	39.2	6.8	3.7	81.7	21	−30
Prince George	1,870	38	58	68	20.0	5.6	5.7	8.3	25	−57
Fort St. John	2,500	35	59	106	15.7	6.7	4.6	−12.6	29	−65
Watson Lake	2,190	29	56	88	15.8	5.9	5.0	− 3.7	20	−74

*Temperature in ° F.; precipitation in inches.

[a] The average period in days between the last temperature before July 15 and the first tem perature after July 15 under 32° F., as registered in the Stevenson screen, 4.5 feet above the ground.

[b] After Thornthwaite.

[c] After Thornthwaite.

tion of zonal soils[15] and natural vegetation reflect the climatic diversity of the Valley. Grassland soils occupy most of the Valley floor and adjacent terraces, except in the northern quarter and on the higher slopes where podsols dominate. In the Brown soil zone rainfall averages less than 10 inches annually. Summer temperatures are high and moisture deficiency is acute (Table I). Drought-resistant plants such as sagebrush, cactus, and bluebunch wheatgrass are common. Several districts within the Brown soil zone have been irrigated, the most important of which are on the Penticton terraces around the southern shore of Lake Okanagan and in the Oliver area. The former is the principal peach growing district in the Valley.

Climatic factors favor the raising of tender stone fruits. On the average extreme minimum temperatures remain over −12 degrees F. in winter and consequently winter killing is not a problem.[16] Relative humidity in summer is low and the peach trees are comparatively free from parasitic fungi. The growing season is over 215 days and the frost-free period over 150 days. Terraces are favored locations because they are protected against late spring and early autumn frosts. Summer temperatures (June, July, and August) average 66 degrees F.

In the Oliver-Osoyoos irrigated areas the growing season usually begins by the middle of March. Specialized fruits and vegetables such as cantaloupes, tomatoes, and cucumbers ripen by midsummer, and consequently the district has a climatic advantage for early marketing.

The Dark Brown soil zone occupies

[15] C. C. Kelley and R. H. Spilsbury: "Soil Survey of the Okanagan and Similkameen Valleys," Dom. Dept. of Agr., Report No. 3, Ottawa, 1949.

[16] The most serious exception was in the winter of 1949–50 when the temperature sank as low as −16 degrees F. at Penticton. Widespread damage followed, and in the summer of 1950 only 5 per cent of the trees were capable of yielding fruit.

the south-central part of the Valley especially in the vicinity of Kelowna. It is also found just above the Brown zone on the valley sides to a maximum elevation of 3500 feet. Rainfall is from one to three inches higher annually and temperatures are slightly lower throughout the year than in the Brown soil zone. The natural vegetation consists of short bunch grasses and thin stands of yellow pine. Where irrigated the Dark Brown soils give excellent yields of principally apples but also grapes, pears, cherries and vegetables. The growing season is too short and the average extreme temperatures are too low for peaches or apricots. The unirrigated sections are suitable for range use.

The Black soil zone is best developed on the lowlands in the vicinity of Vernon. At higher elevations Black soils are common up to 4500 feet in the most favorable south-facing slopes. In general, average annual precipitation is 15 inches and average summer (June, July, and August) temperatures are 66 degrees F. in the Black zone. The soils under more humid conditions support a more luxuriant bunch grass than in the Dark Brown zone. Groves of aspens associated with moist hollows are scattered throughout the district. Irrigated orchards, mainly apple, are an important feature in the agriculture of the Black soil zone. Many areas have been appropriated for winter wheat farming; yields are high often averaging 40 bushels per acre. Lands having a topography too rough for farming are used mainly for cattle ranching.

Podsols (interior) are found in the northern part of the Valley and along the highest slopes. The relatively cool, humid climate is expressed through the natural mixed forest cover of chiefly Douglas fir, Western red cedar, lodgepole pine, white pine, and aspen. Arable land in this section is used for mixed

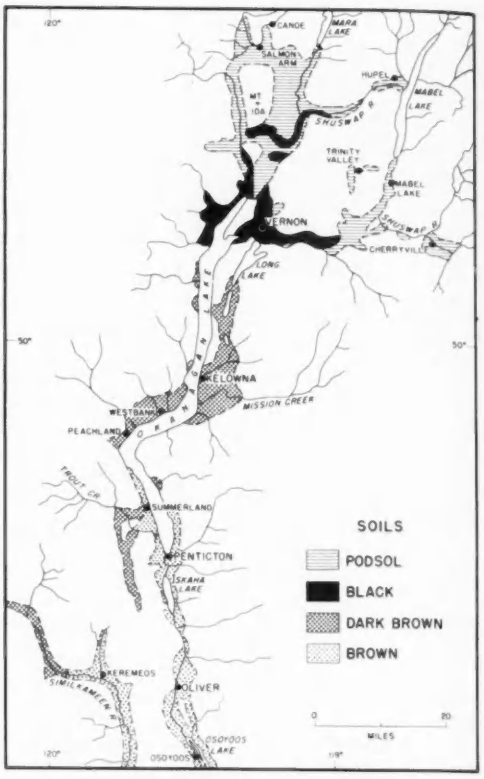


FIG. 5. Distribution of zonal soil groups in the Okanagan-Similkameen District (After Kelley and Spilsbury, Soil Survey of the Okanagan Valley, reference 14).

farming. Dairying is the most important industry.

Occupied farm land comprises nearly 450,000 acres in the Valley of which approximately 160,000 acres is classified as improved. Of the improved land, just over 50,000 acres are irrigated and the remainder is used for field crops and controlled pasture. Most of the unimproved land in the southern and central sections is grass-covered and forms the resource base of the ranching industry. Fully 50 per cent of the unimproved land in the podsol zone is forested.

(b). Patches of cultivated land are found in the Middle Fraser Valley (Cariboo-Chilcotin country) from Quesnel to Lillooet. The chief crop is alfalfa

which is fed to the range livestock in winter. Most of these pockets are irrigated but farming under natural conditions is more common in the Quesnel section. Some vegetables and fruits are also raised. Conditions are similar in the Middle Thompson, Lower North Thompson, Nicola, and adjacent valleys. While the main crop is alfalfa, orchards appear in the South Thompson Valley east of Kamloops, market gardens featuring potatoes and tomatoes on the terraces around Ashcroft.

Within the trenches of the Eastern Cordillera, many terraces are being farmed under irrigation, dry farming is common in the valley floors and mixed farming dominates in the humid sections. Orchard fruits are raised in the Kettle Valley but vegetable seeds, especially carrot and onion, are the chief cash crops. In the Revelstoke-Arrow Lakes districts within the Selkirk Trench, average annual rainfall exceeds 20 inches and mixed farming with emphasis on dairying and poultry raising is scattered throughout. Semi-commercial, part-time farming prevails and value of farm sales is low. The southern part of the Purcell Trench between Kootenay Lake and the American border is intensively farmed. The terraces are irrigated for tree-fruits of which the cherry is most significant. Much of the alluvium in the valley floor has been reclaimed and dyked for wheat cultivation. Yields average 60 bushels per acre. Periodic flooding by the Kootenay River is a major disadvantage.[17] Doukhobors have established farming settlements in the Kootenay

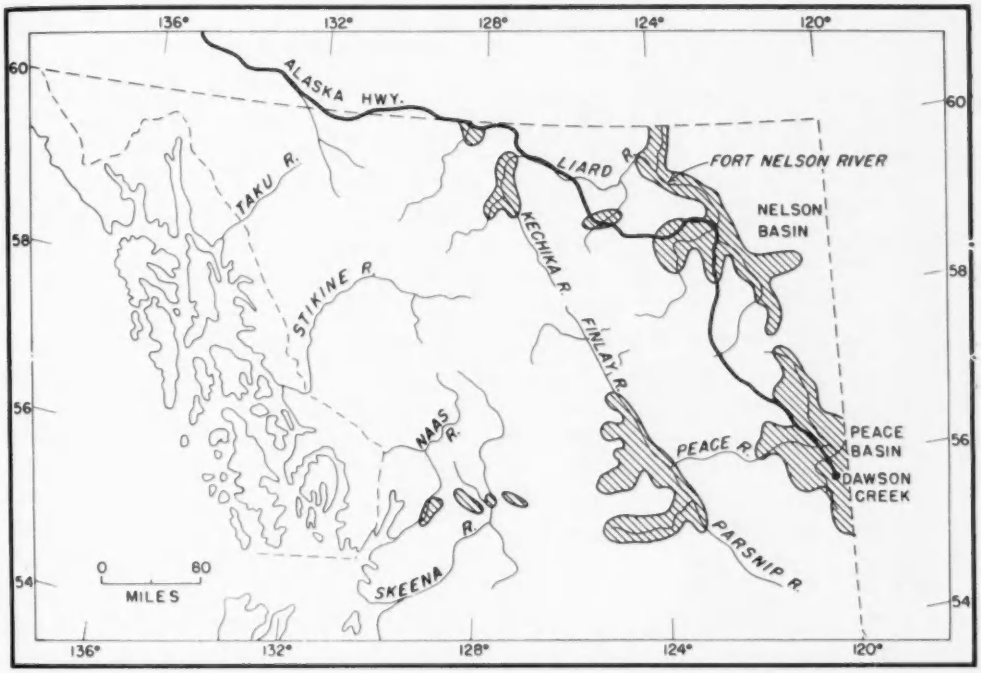


FIG. 6. Arable land in northern British Columbia. Most of the arable land in northern British Columbia is found either in the Peace or Fort Nelson Basins within the Tramontane Plains physiographic division. Patches obtain in the Rocky Mountain Trench drained by the Parsnip, Finlay, and Kechika Rivers. (Source: Canada's New Northwest, reference 12.)

[17] In the summer of 1948 no crop was raised since the entire lowland area was submerged until late July.

district but mainly in the Kootenay Valley between Nelson and Trail. Dairying, fruit and vegetable farming, and small grain production characterize their economy. In the Rocky Mountain Trench farming communities are centered principally in the vicinity of Cranbrook and Windermere. Average rainfall is less than 13 inches annually, but dry farming is attempted in the damp bottomlands.

In the Southern Interior Valleys from the Coast Mountains on the west to the Rockies on the east and northward to the Pioneer Farm Belt (Fig. 3) the raising of beef cattle and sheep is an important aspect of the agricultural geography. Principal districts are the Cariboo, Chilcotin, Nicola, Thompson, Okanagan, and Rocky Mountain Trench. Approximately 350,000 cattle and nearly 140,000 sheep are ranged throughout the area chiefly in the Chilcotin, Middle Fraser, and Thompson Valleys. Herds migrate considerably during the year, grazing on the alpine pastures in summer and in the valleys in winter. From time to time, especially after a heavy snowstorm, supervised feeding is necessary.

THE NECHAKO PIONEER FARM BELT

Agricultural communities comprising in total approximately 90,000 acres of cultivated land are widely scattered along the Canadian National Railway from McBride westward to Smithers. To the west of McBride, the Rocky Mountain Trench merges imperceptibly with the Nechako Plateau, a relatively low area having a moderately subdued topography. Post-glacial lakes were numerous in the area and most soils have formed on a lacustrine base or a relatively stone-free till. However, the majority of zonal soils are classified as Grey-Wooded[18] and are, in the main, strongly leached, acidic, and rather poor in structure. Productivity is maintained only through careful management.

Climate influences the nature of agriculture in the area profoundly. Summer frosts occasionally strike and sensitive plants are damaged. In addition, severe cold spells with temperatures approaching −30 degrees F. are to be expected every winter. Consequently hardy fruit trees, for example, are restricted because of winter killing. Crop failures have never been caused by lack of moisture, but, on the contrary, harvesting has been frequently interrupted by continuous rains in early September. Six unsuccessful harvests in the Prince George area in the last 30 years may be attributed to such conditions.

The chief cash crop in the area is alsike or timothy seed.[19] Being light in weight and high in value it may be shipped to distant markets at relatively low rates. Degraded Black soils formed on south-facing slopes principally in the Vanderhoof, Burns Lake, and Smithers districts are highly prized and support moderately successful oats and wheat farms. Small surpluses are normally sold in other parts of Canada. Fully 50 per cent of the cultivated land is in hay, and dairying is important in the Prince George and Telkwa sections where creameries have been built. Turnips, peas, cabbages, and other vegetables and small fruits are consumed locally.

THE PEACE RIVER BLOC

The Peace River Bloc in northeastern British Columbia is physically and to a

[18] C. C. Kelley and L. Farstad: "Soil Survey of the Prince George Area," Dom. Dept. of Agr., Report No. 2, Ottawa, 1946.

[19] W. J. Anderson: "A Study of Land Settlement in the Prince George–Smithers Area, British Columbia," Dom. Dept. of Agr., Publ. No. 794, Tech. Bull. No. 62, Ottawa, 1947.

great extent economically a part of the large Peace River district of Alberta. Most of the land to the east of the Rocky Mountain foothills presents a rolling surface at about 2200 feet above sea level, cut by large rivers by as much as 500 feet. Open prairies dotted the landscape in the pre-settlement period. Such areas contained degraded Black soils which were inherently fertile and invariably stone-free. They comprised the superior agricultural lands of the area. The growing season is short, but summer frosts are less frequent than in the Nechako district. Furthermore, summer temperatures are slightly higher and the late summer is much drier. All in all, the agricultural climate is superior to that of the Nechako Pioneer Belt. Over 200,000 acres are under cultivation within the region. Wheat is the chief crop in the area. Hogs and beef cattle are raised and some dairying has developed near the small towns. Clover seed is grown and its sale contributes substantially to the income of many farmers.

SUMMARY

To recapitulate briefly, the farming communities of British Columbia are widely scattered and are found within narrow valleys in the Cordillera and on the Great Plains to the northeast. Fully 90 per cent of the Province has a topography unsuitable for agriculture. The amount of potential agricultural land can be further reduced by an examination of the climate and soils. Probably those valleys in Northern British Columbia (Fig. 6) which contain agricultural soils will never under present conditions support a prosperous agricultural industry because of summer frosts. Admittedly certain plants may be adapted in future to the climatic environment. Finally, in many areas throughout the southern part of the Province, where the topography and climate are suitable for agriculture, stony or nutritionally deficient soils constitute permanent handicaps. These areas can more effectively support a commercial forest than an agricultural industry.

A TECHNIQUE FOR CONSTRUCTING A POPULATION AND URBAN LAND USE MAP*

William Applebaum

Mr. Applebaum, Assistant General Manager of Stop & Shop, Inc., Boston, has pioneered in marketing geography. He is especially known for his use of geographic techniques in guiding store locations.

POPULATION data alone are not sufficient for the construction of an accurate population map of a city. Even if such data were available by city blocks, which is rarely so, information on the use of land is essential for an accurate allocation of population *within* each block. Furthermore, the land use data can be employed to chart nonresidential uses on the same map.

This paper has a twofold purpose: first, it deals with the sources and nature of the available urban land use and population data; second, it describes a technique which the author has used since 1931 in constructing over a hundred urban population and land use maps.[1]

This technique is a useful tool to marketing research and city planning.[2]

Urban Land Use Data

The land use of the urban areas in the United States is fairly completely mapped, thanks to the service of the Sanborn Map Company, which has constructed maps and atlases for practically every city, town, and village, and many unincorporated communities in the United States.

The Sanborn maps are plotted on uniform-size sheets to a scale of 1 inch to either 50 or 100 feet. These maps show streets, blocks, lot lines, structures, railroad tracks, and other features of the cultural landscape; the material of construction, use, height, shape, and other characteristics of each structure are designated by various conventions. The Sanborn Company maintains a nationwide service which enters corrections on the maps at frequent intervals.[3]

Sanborn maps are available in every substantial urban community, either in the City Hall, the County Court House, or a realtor's office. All fire insurance rating bureaus have Sanborn maps. Frequently, such a bureau may have atlases for practically every city, town, and village for an entire state. Some of these bureaus supplement the Sanborn maps with charts of their own construction.

In addition to the Sanborn maps, urban land use data are available in many city planning offices.[4] The scale

*This paper, given originally before the Association of American Geographers in December, 1935, has been revised and brought up to date to meet a continuing interest in the subject. The author avails himself of this opportunity to express appreciation to Clarence E. Batschelet, Chief, Geography Division, Bureau of the Census, for valuable help in the original preparation and present revision of this paper.

[1] The author developed this technique in 1931 in the course of his work on the secondary commercial centers of Cincinnati. Subsequently, he and others have used this technique in the study of urban markets.

[2] See "Population Analysis of Small Areas," Business Information Service, Office of Domestic Commerce, U. S. Department of Commerce, Washington, D. C., May, 1950.

[3] For a full discussion of Sanborn maps see the excellent article by Robert L. Wrigley, Jr., "The Sanborn Map as a Source of Land Use Information for City Planning," *Land Economics*, May, 1949, pp. 216–219.

[4] The Housing Act of 1949 requires a community to prepare a land use plan to qualify for federal aid for slum clearance and urban development.

and technique employed in plotting land use data varies somewhat with each city planning office. These maps do not depict the characteristics of buildings as completely as do the Sanborn maps.

Population Data

The population of all incorporated places regardless of size was enumerated in 1930, 1940, and 1950 by enumeration districts. For each smaller place there may have been only one enumeration district. These enumeration districts vary in size of area and number of population. Most enumeration districts in 1950 have between 900 to 1000 people, although the range is from 0 to over 2000, and the over-all average is somewhat under 700.[5]

Population figures by enumeration districts can be procured from the Bureau of the Census at a nominal cost for photostatic reproduction. Maps showing boundaries of enumeration districts are more expensive (but reasonable) because the boundaries must be drawn by hand. Photostats of typed verbal descriptions of enumeration district boundaries can be secured at less expense.[6]

Technique for Constructing the Map

With an adequate base map, population and land use data, and a city directory, the construction of a map showing the distribution of population and urban land use is not difficult. First the boundaries of all enumeration districts are laid off on the base map; then the various land uses in each block are transferred from a Sanborn Atlas to the same base map. Different colors or conventions are used to designate the various types of nonresidential use.

Block data on dwelling units were published by the Bureau of the Census for 1940 (not available for previous Censuses), and are being published for 1950, for cities with a population of 50,000 and over. Hence, it is a very simple matter to enter on the base map the number of dwelling units in each block. However, for cities with populations of less than 50,000 the number of dwelling units in each block is ascertained, within a tolerable margin of error, by counting the "family" dwelling units on the Sanborn maps. A city directory is consulted to determine the number of apartments in each multiple family building, as the Sanborn maps do not show this information. Since these maps do show the address of each building, comparatively little time is consumed in consulting the city directory.

The Sanborn maps usually do not cover the very sparsely populated areas along the fringe of a city. Hence a small amount of supplementary field work is necessary to complete the information.

The next stage in the procedure involves the allocation of population within each block in every enumeration district. The number of dwelling units is computed for each enumeration district and divided into the total of the non-institutional[7] population within the district; the quotient obtained repre-

[5] The low average is due to two factors: (1) most institutions were made separate enumeration districts and (2) the need for observing the boundaries of local political divisions of areas resulted in many cases in enumeration districts with little or no population.

[6] See also the valuable index to the 1950 census data on population and housing for areas smaller than states, U. S. Census of Population and Housing: 1950. "Key to Published and Tabulated Data for Small Areas," U. S. Government Printing Office, Washington, D. C., 1951.

[7] Where enumeration districts still contain institutional as well as non-institutional population, it is necessary to subtract the institutional population from the total population in the enumeration district and to locate the institutional population where it belongs on the map.

sents the population index per dwelling unit for the district. Population for each block is computed by multiplying the number of dwelling units in the block by the population index per dwelling unit. The number of people computed for each block is recorded inside the block on the base map.

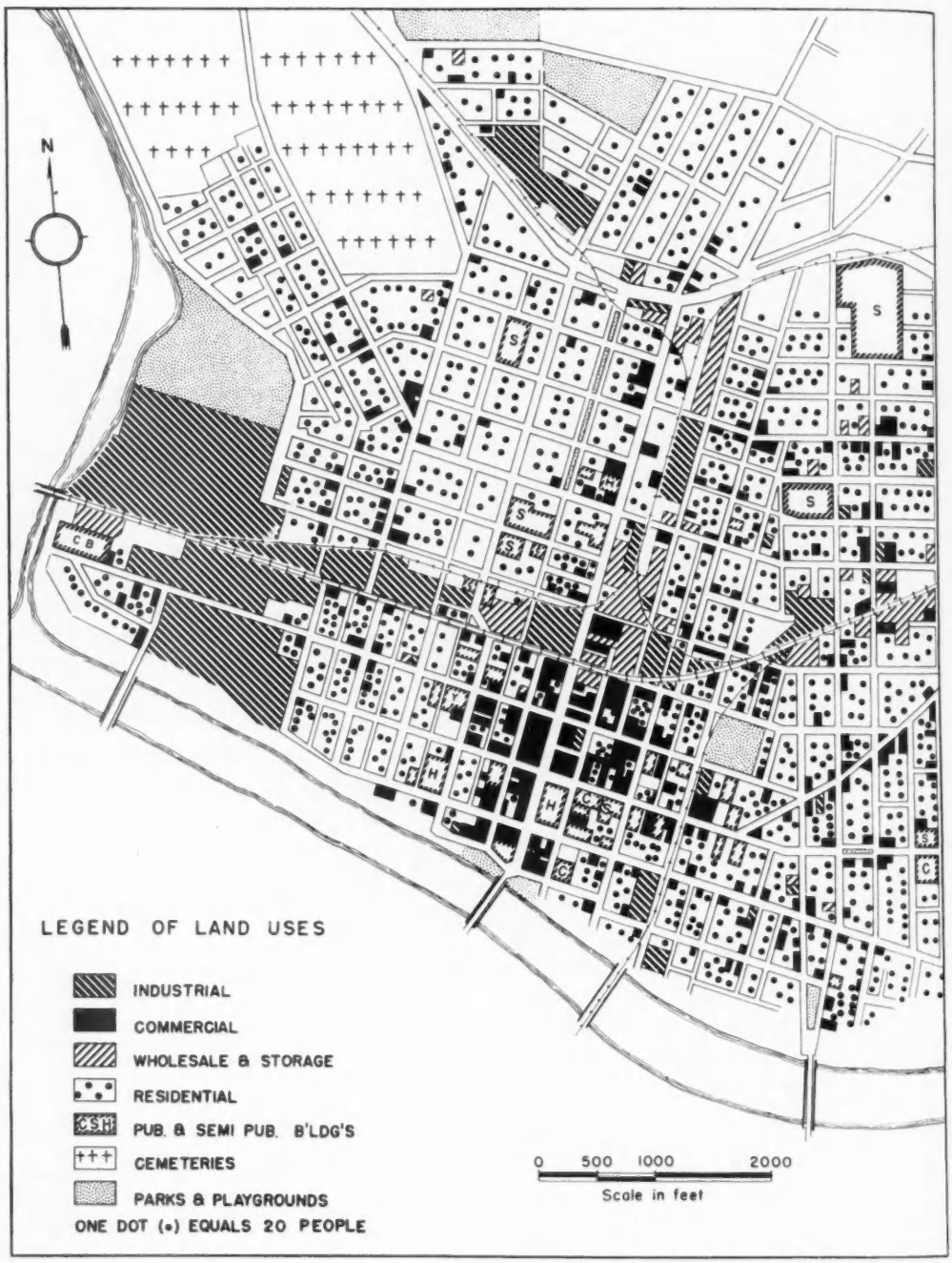


FIG. 1. A population and urban land use map such as this is the end product of the method described.

The final stage of the work is chiefly a matter of drafting. A cloth tracing is made of the city base map and upon it are plotted the population data by dots—for smaller cities 10 or 20 people to the dot, for larger cities as high as 50 people may be represented by a dot. Care should be exercised in allocating the dots within each block to conform with the residentially used land.[8] Circles instead of dots may be used to designate institutional population. When the dots have been plotted, the product represents a population map. The addition of the nonresidential uses to the same tracing completes the map. Obviously the dots designate residential land use and at the same time present a graphic as well as a quantitative measure of the distribution of urban population.

[8] In the preparation of a black and white map, difficulties arise in showing residential and other uses where the buildings are multifunctional, hence some compromise in drafting is unavoidable.

Appraisal of the Technique

Slight inaccuracies are inherent in this method of procedure as it ignores home vacancies, demolition or construction of dwellings since the last census enumeration, "doubling-up" of families, and residential occupancy of normally nonresidential structures; some error arises also from the use of dots having a round value of population. However, these inaccuracies are within a tolerable error.

From the standpoint of time and cost involved, this technique is believed to be the most satisfactory developed to date and has been employed successfully in the study of many urban markets. The author has been able to construct such a map for a city of 100,000 population in one week, and for a city of 500,000 population in about three weeks —including the supplementary field work done by automobile, but excluding the final ink drafting.

BOSTON'S CHINATOWN

Rhoads Murphey

Dr. Murphey is Assistant Professor of Geography, University of Washington.

BOSTON'S Chinatown is the fifth largest in the United States, following San Francisco, New York, Los Angeles, and Chicago. Situated in a tongue of the low-rent district and on the margins of the downtown business district (Fig. 1), the sequent occupance of the area has included several foreign communities, of which the Chinese is the most recent. The association of low-rent areas with foreign occupance is a familiar feature of most American cities. In Boston, the case of Chinatown illustrates both this association and the particular problem of Chinese in the United States.

Physical Character

This is made land, reclaimed by filling a tidal flat between 1806 and 1843. It was in 1840 far enough from Boston's downtown core for residential development and near enough for convenience, a logical place for new housing in the era before automobile and railway commuter transport made settlement possible farther out. Made land in the central Boston area is usually associated with low rents and low land values, a situation which is partly explained and partly made use of by large space-users considered "undesirable" by householders: industry, wholesaling, railways, and cheap housing. These developments required ample space, the nearer to the center of the city the better. Made land answered their needs, and their use of it tended to keep land values and housing rents there low.

Railway connections were completed from Boston to New York by the late 1840's, with the Boston terminus at South Station (Fig. 1), which was also used as a terminus by the main line west to Albany. During the next 20 years the expansion of yard and terminal space erected a barrier to further growth of the new residential area eastward and southward, and in addition acted to depress land values in the sector already occupied by housing. The presence of the railway after 1850, and the low value of the made land, attracted the leather industry into the three blocks between South Station and the present Chinatown, where it had easy access to transport for hides from New England and the West, and by sea. This solid industrial and wholesaling development filled in the last gap in the barrier to the east.

After 1860, the garment industry, displaced from the growing retail district along Washington Street and from the older center of the city by rising land values, began to enroach onto the made land from the west and north. The building of an elevated railway in 1899 through the northern part of the present Chinatown (Fig. 2) depressed rents and land values to a new low, and stimulated further invasion by the garment industry. The garment industry has continued to spread into the Chinatown area through the 1930's and 1940's, almost completely replacing the original residential development in its northernmost block (north of Beach

Street, Fig. 2), and sending fingers into most of the remaining housing area, including a wall of fifteen-storey textile wholesaling and manufacturing buildings erected during the 1920's and 1930's along the major east-west artery of Kneeland Street, which bisects Chinatown.

The original housing in this area has been most seriously cut into, however, by the demolition of tenements to save taxes following the universal drop in land values after 1928 unaccompanied by a decline in assessments. By 1950 total housing space in Chinatown had been reduced by more than one-third as compared with 1925. The neighborhood is within easy walking distance of Boston's major commercial center along Washington Street, with its subway junction and large department stores. There is thus a ready use, as parking lots, for land cleared by demolition, and parking lot signboards give prominent notice that they are "only five minutes' walk from Filene's."

With encirclement by incompatible land uses virtually complete, the original residential neighborhood remained as a low-rent housing pocket, connected with the poor-quality housing area of the South End (Fig. 1) only tenuously across the railway tracks. The future of this residential district is made additionally uncertain by two more recent developments: the purchase by the New England Medical Center of an entire city block within it (bounded by Oak, Harrison, Harvard, and Tyler Streets, Fig. 2) and their subsequent demolition of most of the housing there; and a proposed traffic artery of the City of Boston, a section of which would include a freeway through the neighborhood occupying three additional blocks.

In approximately 120 years, the physical character of the area has thus shown a continuous decline. This pattern is logically reflected in the occupance of the area by successive groups of foreign immigrants, each inheriting a neighborhood increasingly deteriorated, and each replacing in turn an earlier group which had moved out as it had moved up economically and socially.

SEQUENT OCCUPANCE

The original inhabitants of the new housing built between 1835 and 1850 were middle-income native Americans whose economic position is recorded in the nature and quality of the remaining original buildings. The arrival of the railway on the area's eastern borders and the subsequent development of the leather industry articulated with it coincided with the beginning of mass Irish immigration to Boston. Records of the Quincy School (at Harvard and Tyler Streets, Fig. 2) begin to show a preponderance of Irish names about 1858. It seems likely that the advent of the railway and the industrial growth around the borders of the area had combined by the 1850's to lower rents and land values sufficiently to open the neighborhood to immigrant Irish settlement. At the same time, new and more desirable residential areas were being developed farther out from the center of the city, made accessible by the new railway connections, and to these native families tended to move.

The Irish remained the major occupants until the 1880's. The tenements were now 30 or 40 years older than when the Irish first came, and the physical character of the neighborhood had continued to decline, especially with the encroachments of the garment industry. This meant not only less pleasant, but cheaper living. Like their native predecessors, the Irish began to move out to more attractive neighborhoods, now made more accessible by horse cars and the first electric cars in addition to the

railways. As an established American group and a notable feature of Boston life by the end of the nineteenth century, many of the Irish were able to rise into higher income brackets and to graduate into appropriate surroundings to which access was also possible socially. Their places were gradually taken by new immigrant groups, who inherited a neighborhood which had already declined far below its original income and social level, as well as in its physical character. Immigration in the 1880's and 1890's was however far more heterogenous in nationality than in the heyday of the Irish invasion, and the new groups tended to overlap each other in their occupance of this by now traditional first stop on the road to Americanization.

The Irish were superseded in this area by Central European Jews and by Italians, part of the later wave of nineteenth century immigration, whose arrival followed on the intensified invasion by industry and the railway yards. The Jews and Italians never spread over the entire neighborhood, and were apparently there only briefly, since by 1900 it was predominantly Syrian. Jewish and Italian names show up simultaneously in the records of the Quincy School, beginning in 1885 and nearly disappearing by 1900, when

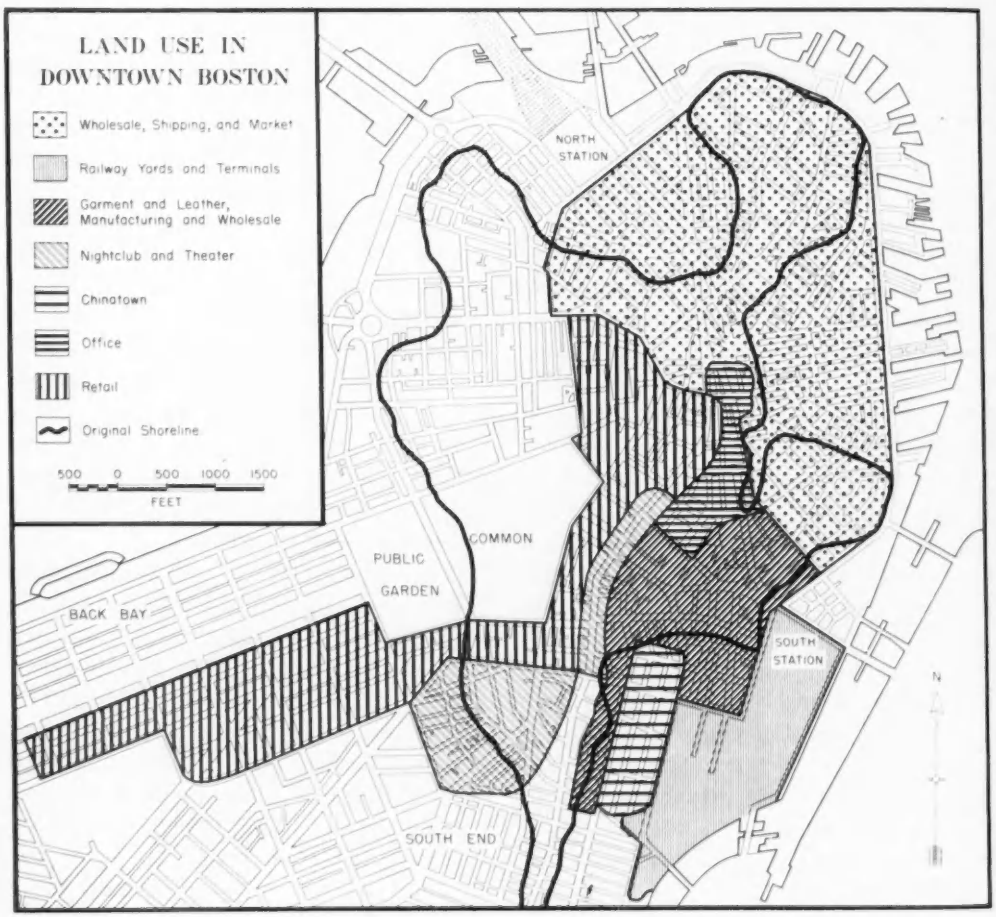


FIG. 1. Land use in downtown Boston in relation to original shoreline and to the present extent of Chinatown.

they are replaced by Syrian names. These approximate dates for the occupance of the different groups are confirmed by the present residents of the neighborhood. Universal school laws were not in effect at that time, and it is reasonable to expect that newly arrived immigrants with a language problem might not send their children to the public schools for the first few years. School records are however the only reliable evidence, aside from eye-witness accounts, of changes in the nature and density of the population in such special areas of American cities before the period covered by census block statistics, where parish records include only one religious group of many and where large numbers of people have no church connections. Sooner or later all groups are represented in the schools, and it is fortunate in this case that the records of the Quincy School extend back over such a long period. Jews and Italians are now important groups in the western and southern portions of the South End (Fig. 1), to which many of them moved from the present Chinatown. The Syrians are now, after 50 years' residence, in the final stages of moving out, as increased income and easier acceptance by the American community have made moving possible. They have been replaced by Chinese except in the southernmost part of the neighborhood, along the north side of the railway tracks.

It is in keeping with the record of decline in the physical character of the area that, following the original native inhabitants, succeeding immigrant waves have had a lower and lower status in American eyes and have been progressively more foreign: from Ireland across Europe through Jewry and Italy to Syria, and finally to China. By 1890, a Chinese community had been established on Oxford Street and the corresponding block on Harrison Avenue, in the northern part of the area (Fig. 2). The outstanding attraction of this neighborhood for the Chinese was clearly its low rents, which had gradually fallen as successive immigrant waves passed through it, each group leaving the tenements shabbier and each year seeing

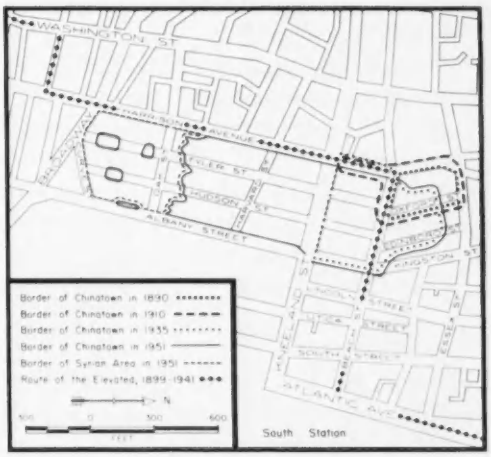

WASHINGTON ST
ALBANY STREET
Border of Chinatown in 1890
Border of Chinatown in 1910
Border of Chinatown in 1935
Border of Chinatown in 1951
Border of Syrian Area in 1951
Route of the Elevated, 1899-1941
South Station

FIG. 2. Expanding Chinatown, 1890–1951.

the deteriorating effect of the railway yards and encroaching industry gathering force. In addition, it was the nearest low-rent housing area to the railway station. As the Chinese themselves explain, their first settlements in most cities tend to be near the railway station as their first point of entry into a strange place where the language and ethnic barriers restrict their range and encourage them to keep in close contact with transport to friends and relatives in other cities. This seems to have been the case in Chicago, Pittsburgh, Los Angeles, and St. Louis. In New York and San Francisco, where the majority of the Chinese arrived by ship, the Chinatowns are more closely articulated with the harbors. As a general principle, American Chinatowns are closely oriented to transport terminals.

Some of the older residents of Chinatown suggest that the first Chinese to

come to Boston were runaway crews from ships in the harbor, but this does not seem as likely a source as California. Chinese immigration into California began in force about 1852, and averaged nearly 30,000 a year through the 1860's. Their labor was important in the building of the transcontinental railways, but with the completion of the Central Pacific in 1869 feeling began to turn against them, and in 1871 the anti-Chinese movement began with a series of race riots in which several Chinese were killed. Chinese migration from California to east coast cities began at about that time, and the total Chinese population of California continued to fall until the present, when New York's Chinatown is only slightly smaller than San Francisco's.

The appearance of the first Chinese in Boston was delayed as late as 1869 or 1870, and was apparently in no way connected with Boston's earlier prominence in the China trade. The Canton system under which foreign trade with China operated from its large-scale inception in the eighteenth century until the Treaty of Nanking in 1842 between China and Great Britain (extended to the American trade by the Treaty of Wang Hsia in 1844), kept the foreigners on the outer margins of the empire and reduced to a minimum contact between foreign traders and the Chinese people. The handful of Chinese who entered California in the 1830's and 1840's were the accidental flotsam of trans-Pacific trade. Emigration to the United States did not begin on a significant scale until about 1850, after China's traditional barriers against the barbarians had been repeatedly breached by the military victories of and trade concessions to the Westerners. By that time Boston had largely lost its prominence in the China trade, and California had become the logical point of entry for Chinese immigration.

The subsequent movement of Chinese from California to east coast cities as a result of anti-Chinese prejudice was slow in gathering force, especially since a good many Chinese, employed as railway laborers, made the move overland. New York's first Chinese arrived by ship from San Francisco in 1852, although this single immigrant was not joined by others until 1862 and there were not enough Chinese in New York to open a purely Chinese establishment (in this case a trading company) until 1878. The first chance arrivals, and the earlier start of group immigration than in Boston were due to New York's position as the terminus of the sea route from California, a cheaper and easier highway to the east. Boston's Chinese population seems to have arrived almost entirely overland.

At present, out of an estimated total for Greater Boston of approximately 2500 Chinese, about 2000 live in Chinatown.[1] This would appear to have been a constant approximate ratio of 80 per cent since 1890, according to old residents and to contemporary newspaper references and police records (the Census figures for Boston were not broken down into block statistics until 1940). On this basis, the population of Chinatown was about 200 in 1890, 500 in 1900, 900 in 1910, 1000 in 1920, 1200 in 1930, 1300 in 1940, and 1600 in 1950.

In settling by the Elevated (Fig. 2) the Chinese repeated the pattern already established in New York's Chinatown, which had attached itself to the low rents along the Third Avenue Elevated. With the encouragement of this new depressant of rents and land values, Chinese settlement in Boston spread between 1905 and 1925 to the traffic

[1] "Chinese Directory of Boston and New England," New York, 1949 (in Chinese).

artery of Kneeland Street. To the north, long established garment industry in large buildings barred the way (Fig. 1), to the east, the leather industry formed a barrier, and to the west, commercial development with its high rents and lack of housing provided the strongest wall of all. On the south, however, the Syrians were beginning to graduate from their immigrant status, and were retreating especially from the blight of the Elevated to the quieter and pleasanter area south of Kneeland Street. The solid blocks of tenements which they left behind were gradually altered by the Chinese to house restaurants, groceries, trading associations, and art stores, as well as families. Until about 1940, the boundary between Chinese and Syrian occupance remained along Kneeland Street.

LIVELIHOOD

Chinese are the ultimate foreigners in the United States. The majority of those who live and carry on their business in Boston's Chinatown do so because race prejudice makes living and business difficult or impossible elsewhere. American laws until recently denied citizenship to all Asians, and they are in this country only on sufferance. The

FIG. 3 (upper left). A symbol of conflicting land-uses: two Chinese art importers flanking the front door of a large garment factory on Hudson Street, of which they occupy the ground floor. Note occupance of the six upper floors, according to the sign board. The children are a new feature in Chinatown, and provide a clue to its present problems, in which the garment industry also plays a part.

FIG. 4 (upper right). Housing area south of Kneeland Street, now predominantly Chinese. Demolition for parking lots shows in the foreground, and in the far background one of the large garment industry buildings along Kneeland Street.

FIG. 5 (lower left). Restaurants on Hudson Street, looking north toward a large garment industry building on the north side of Beach Street, the ground floor of which is occupied by another Chinese restaurant. New Merchants Association building in right foreground, next to a row of original dwellings now articulated with the restaurants.

FIG. 6 (lower right). Representative housing south of Kneeland Street, in the area's original buildings.

first Chinese came to the United States as coolies for manual labor under an infamous contracting system, and they have remained in the eyes of the American community social outcasts, obliged to live in ghettos in their own way.

Nearly every new immigrant group in American cities has for at least a generation tended to stick together in one area of the city, by choice, and usually also because, for this first generation, livelihood tends to center around particular national skills or trades which are most profitably carried on in the same area. With the second generation, largely educated in American public schools, this areal exclusiveness has usually broken down and the majority of each original immigrant group has dispersed over the city as a whole. The Chinese however have constituted a distinct community in Boston for over 60 years. Choice and economic advantage have certainly been factors in maintaining this exclusiveness, but the uniquely foreign character of the Chinese in American eyes has perhaps been even more important. Americanization of the Chinese has also been retarded by the fact that until recently their community has been predominantly composed of adult males so that few Chinese went through the public schools to learn American ways and language. (This last problem will be discussed in more detail later.)

In such a situation, it is natural that Boston's Chinatown should have become a distinct and close-knit community with special functions as a central place for all the Chinese in New England, who are excluded from most aspects of the general American community. Chinese in New England now number about 5000,[2] most of them inveterate week-enders in Boston. Chinatown comes to life on Friday night and until late Sunday is a hive of activity for Chinese laundrymen and restaurateurs from as far away as Springfield, Mass., and Portland, Maine. They come to see friends and relatives, to speak their own language and live in their own customs, and to find recreation in Chinese opera or gambling, which is unfortunately a major vehicle of organized social activity for at least the older generation.

Boston's Chinese, like most permanent Chinese residents of the United States, are almost entirely Cantonese, from the coastal margins of Kwangtung province. Kwangtung, together with Fukien, is not only a food deficiency area, but is the only part of China with a close orientation to the sea, implemented by numerous excellent natural harbors. The Cantonese, ethnically and linguistically distinct from the main body of the Chinese people, are China's traditional overseas traders and colonizers, and Kwangtung has been for centuries the traditional supplier of emigrants.

Despite its poverty, Boston's Chinatown, like other American Chinatowns, has the lowest crime rate of any area in the city. Its residents are peaceful, law-abiding people, perhaps doubly so because of their uncertain status in this country, and they have an enviable record of good citizenship. This was so in 1882 when the Chinese Exclusion Act was passed by Congress against the objection of many Americans who had seen the sober worth of potential Chinese-American citizens, and it is still true today after a century of anti-Chinese prejudice in this country. Juvenile delinquency is almost unheard of in Chinatown, where parental authority is absolute. In Boston, as in other American cities, the Chinese have moved into a blighted low-rent area and trans-

[2] *Ibid.*

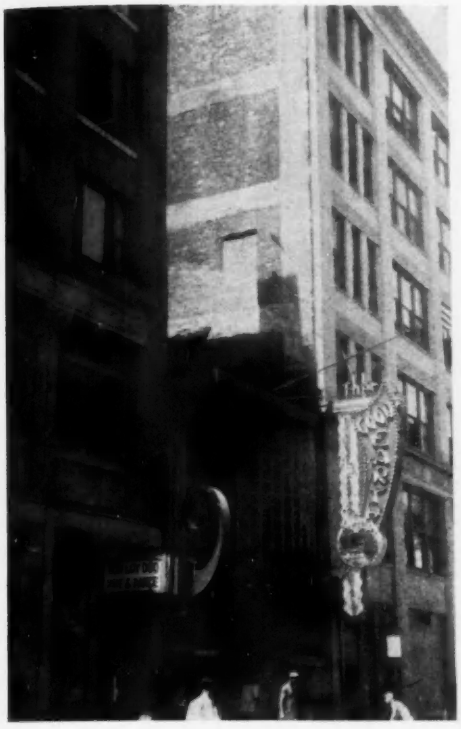


FIG. 7. The Good Earth restaurant, one of the group of postwar additions, sandwiched between two garment industry buildings on Tyler Street, with another Chinese restaurant occupying the ground floor of the building on the left.

formed it into an attractive restaurant and art shop neighborhood whose inhabitants stick zealously to business. Chinatown does not in any significant sense belong to Boston's South End, a rooming-house area which leads the city in crime and juvenile delinquency rates. Property values in Chinatown, in contrast with the Syrian area or with the South End as a whole, did not share the catastrophic downfall of real estate after 1928. Values did drop to be sure, but relatively little, and they have since recovered and exceeded the earlier levels.[3]

In this recovery Chinatown has been materially aided by a *deus ex machina* when the Elevated was torn down for scrap in 1941. Earlier it was said that the Chinese lived there because no one else would, but in 1941 they found themselves on potentially very valuable property. Their area was just behind Washington Street (with its theater district) and convenient to the center of the city or to the Back Bay, an ideal location for restaurants (Fig. 1). The war gave Chinatown a further boost as part of the general acceleration of economic activity, and since 1942 nearly a dozen new restaurants have been built or remodelled, complete with modern architecture and neon signs to attract the non-Chinese trade, replacing or overshadowing the former dingy eating places beside the Elevated. Restaurateurs estimate that before this development three quarters of their business came from their own people, whereas at present the balance is exactly reversed in favor of the non-Chinese Americans.

When the community spread as far as Kneeland Street, the Chinese remodelled the first or second floors of the tenements to house restaurants, grocery stores, or trading companies, and used the upper stories for living space. On the south side of Kneeland Street, where since about 1942 the Chinese have increasingly replaced the Syrians, land use has remained predominantly residential, with parking lots and garment industry buildings the only other important features, although two new Chinese restaurants have been opened there during the past year. There is nevertheless a striking contrast between the bright new restaurants on Tyler and Hudson Street north of Kneeland (Fig. 2) and the dingy tenements in which the Chinese live, often two or three families together and eight people to one room. They suffer not from laziness or sloppiness but from

[3] "Assessed Values of Real Estate in Boston," Volumes for 1901–1948.

pure lack of space. Understandably, this area has one of the highest tuberculosis rates in the city.

The Chinese are still obliged to earn their living primarily on the basis of their nationality and within a separate community. In Chinatown itself there are approximately 26 restaurants; 43 trading companies, grocery stores, merchant associations, and art goods importing stores; 4 Chinese laundries; 1 Chinese printing company; 2 Chinese photographers; and 1 Chinese travel agency and money exchange and remittance service. The only Chinese retail establishments in Greater Boston outside Chinatown are approximately 34 restaurants and 48 laundries.[4] The photography shops are characteristic of the craze in China for photography, and the only other special service (aside from the printer, who has a special enough job in dealing with the Chinese language) is logically the money and travel agency.

The Chinese have selected the means of livelihood in which they could best compete in an unfriendly foreign community. A laundry may be started by an illiterate with no knowledge of English and with a very small amount of capital, and its major requirement is hard work for long hours, a sphere in which the Chinese need fear little competition. The restaurants serve partly a central place function for all the New England Chinese, and more recently are being supported largely by the non-Chinese trade. The grocery stores, also part of Chinatown's central place function, are parasitic on the local and New England Chinese communities, and sell special Chinese food, both imported and raised locally, to restaurants and to Chinese families. The trading companies do some importing of Chinese goods for large American retail stores, but their empty windows and dark interiors indicate that their most important function is as fronts for "clubs."

The Chinese are acutely conscious of the limited employment opportunities open to them. A few fortunate individuals have gone from Chinatown to American universities, and have been able to establish themselves in professions or in business. On the other hand, many of the Chinatown boys who have graduated from American universities in the last few years have been unable to find jobs in their fields and are now working as waiters in Chinatown restaurants. A small beginning is being made on the long road to Americanization, and as the present generation grows up through the public schools they may find acceptance by their fellow Americans easier and opportunities for varied employment on an equal basis more frequent.

Perhaps because they are relatively more recent arrivals, the Boston Chinese seem to have found fewer economic opportunities outside their own community than the Chinese in New York or San Francisco, where several trades and professions not dependent exclusively on Chinese patronage have been opened to them (including domestic service; garment, leather, and tobacco industries; mining; medicine; law; trucking and shipping; banking; and varied retailing.[5] It has remained for the women in Boston's Chinatown to enter non-Chinese industry. Nearly all of the women residents, despite the fact that nearly all of them are married, are employed in the local garment factories, but almost none of the men. They are hired even though they are Chinese because they are willing to work for

[4] "Chinese Directory" . . . , *op. cit.*

[5] G. Y. Leong: "Chinatown," New York, 1936, *passim.*

FIG. 8. Postwar restaurants in remodelled and well maintained original housing on Tyler Street. Part of the Sunday trade is shown filling the street and entering the restaurants. The taxi on the right is pulling out to pick up a Chinese fare for South Station. The building with the fire escapes and the larger one beyond it (across Kneeland Street) belong to the garment industry.

low wages on menial jobs. Businessmen among the Chinese would like to buy an interest in the garment industry as the clearest first step toward branching out into the general economic life of the city, but so far this has been limited to the Chinese ownership of a small company wholesaling textile machinery.

The most obvious landmark in Chinatown has just been completed: a large six-storey building in "modern Chinese" architectural style erected on the northeast corner of Hudson and Kneeland Streets (Fig. 2) by the Consolidated Chinese Merchants and Benevolent Association of New England. This imposing building is to be used primarily as a recreation center, and also to house the offices of the Association. The need for such a center is clear, especially given the particular social problem of the Chinese in the general American community, and the overcrowded depressed area in which they live, but so much Chinese capital available for apparently non-profit investment seems to require an explanation. One answer may be found in the increasing difficulty of remitting money to China. The overseas Chinese in all areas habitually send large proportions of their earnings, however small, back to their relatives in China, or for investment in land there. Political developments in China since 1948 have greatly reduced the volume of this flow, especially from the United States, and may thus have made capital available locally. In this case it is being used for the assistance of local Chinese instead of for those at home, since the Association, as its name implies, acts as a semi-official welfare organization for all Chinese in New England, and is primarily responsible for the fact that no Chinese in this area has yet appeared on federal or state relief rolls.

THE FUTURE

It remains to explain the dynamic factor in the present situation. Chinatown's population has increased by approximately 60 per cent since 1940, and most of the additions have been women. Under the Chinese Exclusion Act of 1882, no Chinese were permitted to become American citizens, but those already in this country and their progeny were allowed to retain citizenship already acquired. Their numbers were added to by considerable illegal immigration. Chinese citizens of the United States, however shady their origin, were permitted to visit China for a maximum period of 18 months without losing their privilege of re-entry, and were entitled to register the birth of two children in China during that time on their return to the United States, children who shared their father's acquired American citizenship. Every Chinese returning to China recorded the birth of two male children, whether or not they had actually been born to him, so that 18 or 20 years later two new Chinese-Americans arrived in the United States, often with names and credentials purchased from their "fathers."

In this situation, almost no Chinese women came to this country. Under the difficult circumstances and large financial expense of emigration to America, it was left for the young male member of the family to make the family fortune overseas and to support not only his wife and children at home but also his many other closely integrated

FIG. 9. The new Merchant's Association building on the northwest corner of Hudson and Kneeland Streets. (Photo by courtesy of Mr. Chin Park.)

relatives. The Chinese population of Greater Boston and of the United States remained about 95 per cent male until 1940.[6] The second world war drastically altered conditions. Firstly, all men who served with the American forces acquired American citizenship if they so desired, and were further entitled to bring wives from overseas quota-free. Secondly, in 1944 the United States revoked the Chinese Exclusion Act of 1882 and put into force the original yearly quota for Chinese of 105. The net effect was to increase the number of women in Boston's Chinatown by at least 1000 per cent, and to permit the community for the first time to grow rapidly, on a family basis.

Chinatown is now bursting at the seams. Events have forced the pace of Americanization, for the Chinese must now find both employment and housing outside Chinatown in the very near future. Aside from laundrymen and restaurateurs, who live on their business premises (they account for nearly all of the approximately 500 Greater Boston Chinese living outside Chinatown), very few Chinese families have been able to move to housing in the suburbs or to other parts of the city. The Chinese are proud and sensitive. As a comparatively tiny group they have not the security of large numbers in moving into a new area against local prejudice, as the Negroes and other minority groups often have. In another 10 or 15 years the first of the war-time group of children will have passed through the public schools and perhaps be ready for acceptance by their fellow Americans. But before that time, especially if this low-rent salient is pinched out by the garment industry, the hospital, and the traffic artery, Chinatown may not be able to contain its rapidly growing population.

The central place functions of Chinatown—the restaurants, merchant and trading associations, groceries, and art stores—will probably remain here for some time in any case. The area is an excellent location both for businesses relying on the non-Chinese trade, such as restaurants, and for goods and services for the New England Chinese, closely articulated as it is with Boston's commercial core on the west and with South Station on the south. But it seems in the long run inevitable that the Chinese must spread out into the city as equal citizens, as each foreign group before them has ultimately done, and as they are now being forced, perhaps prematurely, to do by their need for housing. The development of Chinatown may be expected to follow the general trends of urban growth and change, but the future of Boston's Chinese depends far more on the intangibles of American good will and understanding.

[6] U. S. Census.

PENN TOWNSHIP—AN EXAMPLE OF LOCAL GOVERNMENTAL CONTROL OF STRIP MINING IN PENNSYLVANIA

E. Willard Miller

Professor Miller of the Pennsylvania State College has contributed a number of articles to this magazine in the field of mineral geography.

WITH the development of large earth moving equipment and increasing demands for coal during the past decade, surface mining has greatly expanded. Since 1944 Pennsylvania has been the leading producer of stripped coal with an annual production between 25 and 37 million tons. As a result of this type of mining large areas of unsightly and unproductive spoil banks have been created. The average coal miner has no interest in reclaiming the land. His sole purpose is to secure the coal and then abandon the despoiled area. As the area of spoil banks has increased there has been a growing demand from public spirited citizens, progressive newspapers, and some legislators for an effective restoration program. Several of the more progressive coal companies have restored small areas, and in 1945 Pennsylvania passed a Conservation law to control reclamation on a state basis. While both of these programs appear to be ineffective at the present time, there is one area which, since the beginning of mining in 1940, has had effective control of strip mining and reclamation as a result of local governmental regulations. This area is Penn Township which lies in Allegheny County on the northeastern boundary of Pittsburgh (Fig. 1).

Production Characteristics

Penn Township is richly underlain with coal and underground mining has been practiced for many decades. However, because of the rugged terrain and the residential character of the area, strip mining did not begin until 1940 (Fig. 2). In that year approximately 125,000 tons of coal were produced by stripping. As the demands for coal rose during World War II the strip output increased to a peak of 447,000 tons in 1944. Production has gradually declined since then until in 1948 only 103,000 tons were produced; by the end of 1950 most of the recoverable surface coals will have been mined.

The Pittsburgh Coal Seam furnishes all coal that is strip mined in Penn Township. The thickness of the seam varies from 60 to 72 inches. Generally the bed is double, consisting of a roof division and a lower division, separated by a clay parting from one inch to three feet thick and containing thin bands of coal. This clay parting adds an additional expense to the strip miner in cleaning the coal before it can be marketed. The overburden in the township varies from essentially zero to about 50 feet and is made up primarily of sandstones and shales with an occasional band of limestone. In a few places, through test drilling, it has been found that the surface coal is so thoroughly oxidized that it is not of commercial grade. However, most of the strip coal is a high grade bituminous containing 57 to 65 per cent fixed carbon, 30 to 35 per cent volatile matter,

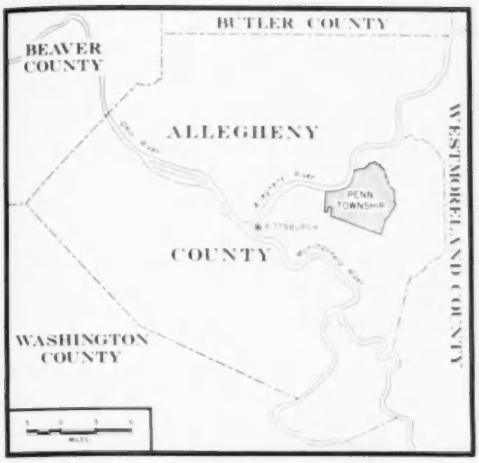


FIG. 1. Location of Penn Township in Allegheny County.

and 4 to 14 per cent ash. The sulphur content is usually about 1 per cent.

PATTERN OF STRIP MINING

The pattern of surface mining is influenced not only by the rugged topography but by the human utilization of the area (Fig. 3). The surface of Penn Township is deeply eroded, having a local relief of 500 to 600 feet, and much of the original coal deposit has been lost by erosion. However, the Pittsburgh seam outcrops near the top of the hills and is readily accessible to the surface miner. Mining is somewhat complicated by the steep slopes of the area.

Besides physical limitations a considerable portion of the township is used for residential and commercial purposes and not available for surface mining. Penn Township, bordering Pittsburgh, is essentially a well-to-do residential suburb. It has a population of approximately 20,000 people, thus having an average density of about 1000 persons per square mile. When the area was first settled it was principally a dairy farming district. A few farms and abandoned areas still exist and these offer the largest available space for surface mining. About 3 per cent of the population is still classified as rural.

From 1940 through 1949 approximately 220 acres were strip mined in the township. In 1944, the year of largest production, about 45 acres were disturbed. In 1948 only slightly more than ten acres and in 1949 less than five acres were stripped.

METHOD OF CONTROL

Penn Township developed its control of strip-mining through the local legislation that is permitted smaller civil units in Pennsylvania. In 1923 the State gave first class townships the right to enact zoning legislation. However, of 28 first class townships in the bituminous coal region of Pennsylvania only Penn Township has enacted such legislation. The zoning of Penn Township was completed in 1940 just prior to the start of surface mining (Fig. 4).

The zoning ordinance established three classes of residential districts, a number of small business districts, and two small industrial and manufacturing sections. The very rugged area lying farthest from Pittsburgh, largely in the northeastern portion of the township,

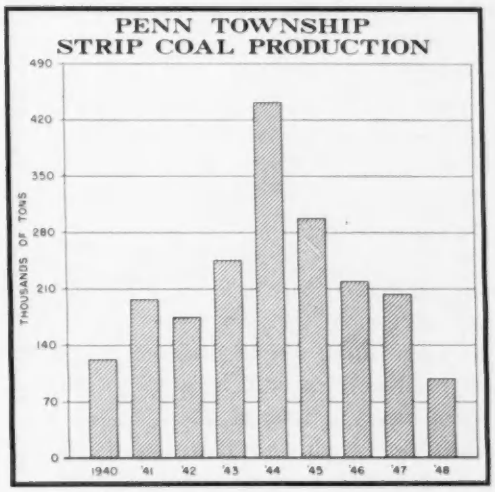
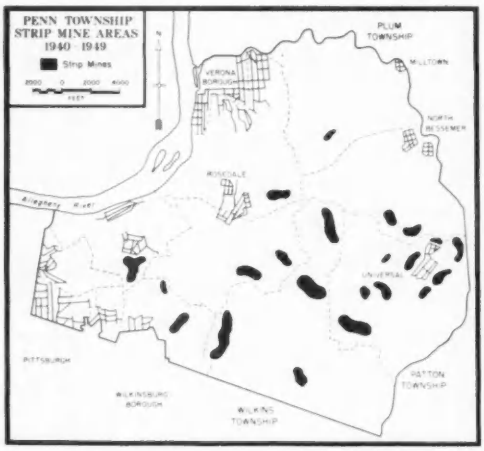


FIG. 2. Strip coal production, 1940–1948.



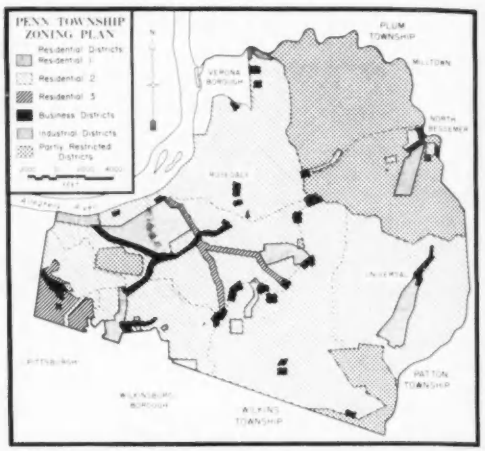


FIG. 3 (left). The pattern of strip mining in Penn Township, 1940–1949.
FIG. 4 (right). Zoning plan of Penn Township.

is zoned as "partly restricted." The zoning law classified, regulated, and restricted the height, number of stories, and size of buildings, the percentage of the lot that can be occupied, size of yards, courts, and open spaces, density of population, and location and use of buildings and areas. As stated in the ordinance, the general purpose of the act is to promote health, safety, morals, and the general welfare of the people of Penn Township. Fines and penalties are imposed for violations.

As a result of the zoning ordinance, strip mining can take place only as a variance to the existing code. The following procedure has been established in order that a strip miner may secure a permit to mine. A Board of Adjustment has been created to control the operations of the zoning ordinance. The miner petitions the Board for a permit and a public hearing date is established. The public hearing must be advertised in a local newspaper for at least three weeks prior to the date, or mail notices may be sent to persons who have registered their names and addresses with the Board. If at the public hearing 20 per cent or more of the residents concerned are unfavorable to the issuing of the stripping permit, it is not issued, except by the favorable vote of 75 per cent of all members of the Board of Township Commissioners. The residents of the area have never stopped the issuing of a permit.

The permit when issued stipulates a number of regulations. The most important of these is that all areas disturbed by stripping must be restored to their original contour. Planting is usually required to prevent soil erosion. The township also requires that any damage done to its highways, sewer system, or drainage ditches as a result of the hauling of coal or through the stripping operations be repaired by the coal company. In order to guarantee that reclamation is completed and all damages repaired a bond varying from $1000 to $3000 per acre is required to be posted, and is held by the township until the ward inspector indicates that all residents of the ward are satisfied with the reclaimed area. This local system of control has proved exceptionally effective.

MINING AND RECLAMATION

Where complete restoration of the land is a part of the mining procedure

the methods employed must be somewhat different from those used when no restoration is contemplated. The first step is to remove the top soil from the section to be stripped and store it on the upper edge of the area so that the soil may be replaced in the restoration procedure.

Strip mining then proceeds as developed throughout the Appalachian coal fields. Mining of the coal begins where the seam outcrops on the surface and extends into the hillside until the overburden becomes too thick or mining is stopped by some type of commercial, residential, or industrial utilization of the land.

In the restoration process, the trench made by the last cut of the shovels is filled and the high wall destroyed. The rocky spoil banks are then levelled and the top soil evenly spread over the surface (Figs. 5 and 6). Since the top soil is loose the contract between the miner and the landowner generally stipulates that some type of planting take place to prevent excessive erosion. If the land is to be used for agricultural purposes a fast growing hardy grain is used. Rye has been found to be an excellent initial cover crop (Fig. 7). Most farmers have indicated that the land is more productive after strip mining and reclamation than before the operation. One farmer claimed his yield of wheat increased from 25 bushels per acre to 35. Dairy farmers have reported that pastures are considerably improved.

If the field is not to be used for agricultural purposes, it is usually planted in some type of grass such as rye grass. In a very few places nature has been allowed to provide a quick cover in the form of weeds (Fig. 8). In several instances stripping and reclamation have greatly improved the land by the re-

FIG. 5 (upper left). Stripped area which is 90 per cent reclaimed. The top soil is now being replaced by a bulldozer.

FIG. 6 (upper right). General view of a reclaimed area in a residential section.

FIG. 7 (lower left). Reclaimed field planted in rye. This initial cover has been obtained in about six weeks after completion of restoration.

FIG. 8 (lower right). Reclaimed area on which nature has provided a covering. This area which adjoins the wealthy Alcoma Country Club illustrates how strip land can be restored and not become an eyesore on the countryside.

FIG. 9. Newly constructed homes on levelled spoil banks.

moval of a brush covering. Also, in a number of places when the land was levelled a street pattern was laid out, and houses are now being built on one stripped area (Fig. 9). Where the fill has not had an opportunity to settle properly, cement blocks are placed under the dwellings to support them. In essentially no places are trees planted in the restoration process.

COST FACTORS IN RECLAMATION

The average yield of coal per acre in Penn Township is about 10,000 tons. The price of coal at the stripping operation has averaged between $3.70 and $4.50 per ton in the past five years. The land in Penn Township is not owned by mining companies, but is leased from individual owners. The royalty paid to secure the coal has varied from 20 to 50 cents a ton, with an average of about 25 to 30 cents. With a clear profit of $2500 to $5000 per acre and a guaranteed reclamation program, landowners have encouraged surface mining. On one or two large estates mining has taken place within 10 feet of homes that have a real estate value of $75,000. In the complete reclamation process, the cost of levelling and replacing the top soil varies from $1500 to $3000 per acre, depending particularly upon slope, type of rock, depth of mining, height of the high wall, and amount of top soil to be replaced.

CONCLUSIONS

Penn Township is the only area of even moderate size that has a successful reclamation program in Pennsylvania. It has been a common argument of strip miners that reclamation will destroy the strip mining industry for restoration would consume all profit. The fact that mining has continued in Penn Township for ten years during which essentially all surface coal has been mined and no bond has ever been forfeited illustrates that complete restoration can be a part of the mining procedure. Penn Township is an outstanding example of control on the local level being wholly successful. It could well serve as a pattern for other townships, boroughs, and cities in the State.

NIAGARA FALLS POWER REDEVELOPMENT

Wallace McIntyre

Dr. McIntyre is Associate Professor of Geography at Illinois State Normal University. His paper is based on his dissertation for the doctorate at Clark University.

IT was once stated that Niagara Falls is the most widely known, and the least understood of all our water powers. The advertising skill which has published its charms so well has established the concept of a small resort town, a brief scenic stop-over near the city of Buffalo. However, Niagara Falls, New York, is far more than a few hotels beside a waterfall, chiefly catering to honeymooners and tourists; it is a thriving industrial city. Its more than 90,000 inhabitants make it the ninth city of the Empire State, while the stench and fumes from its busy factories emphasize the point that Niagara Falls is 75 per cent industrial in almost any way one wishes to measure it.

Metropolis of a trading area of 150,000 population, Niagara Falls is one of the leading industrial centers of North America. In Niagara Falls, New York, over 100 industries give employment to some 30,000 workers, and produce manufactured goods valued at over $200,000,000 annually; in Niagara Falls, Ontario, 6500 persons were employed in manufacturing products valued at more than $61,000,000 in 1947. Electrochemical and electrometallurgical industries predominate, with metals and chemicals, such as chromium, silicon, silicon carbide, carbon and graphite, caustic soda, chlorine, and a host of complex organic chemicals accounting for the greater part of this output. The manufacture of paper, paper products, abrasives, aircraft, storage batteries, food processing machinery, printed business forms, food, and other diversified items complete the leading industrial activity. As most of the products are what might be called "basic," practically every article in everyday use has some contribution made to it by the industries of Niagara.

The ratification of a new water rights treaty between the United States and Canada in August, 1950, and the present large scale construction activity along the Ontario bank of the Niagara River mark the latest turn of events in hydroelectric power generation, the basis for the industrial prosperity and importance of Niagara Falls (Fig. 1).

Historical Growth of Power Development

Historically, power development at Niagara Falls started in 1748 with the use of simple water wheels motivated by the current of the upper rapids, a mile long stretch of rushing water above the Falls. Mill races were constructed along the side of the rapids, and mills were located on islands in the river itself.

The next phase in power development was designed to take advantage of the right angle turn the river makes at the Falls, and the greater "head" or drop available in the gorge carved out by the retreating cataract. This was ac-

complished by the construction of a surface (hydraulic) canal from the beginning of the upper rapids, across the angle made by the turn in the river, emptying into a basin located on the brink of the gorge a short distance below the Falls. Water falling over the gorge wall was first used for power in 1875 to operate a grist mill using the traditional water wheel system. In 1881, a small generator was installed at this site, producing electricity for sixteen 2000 candlepower lights, and marking the first generation of electricity at Niagara Falls.[1]

Growing commercial exploitation of both scenic and power facilities at the Falls culminated in a popular protest, resulting in the setting aside of State and Provincial Parks or Reservations on both sides of the river in 1883 and 1885. In particular, banks along the upper rapids and in the immediate vicinity of the Falls were thus set aside, permanently excluding power facilities from those advantageous sites. Urban growth also concentrated near the Falls, to the detriment of industrial activity. It was the attempt to overcome this locational and spatial handicap that led to the precedent-making hydroelectric developments at Niagara Falls.

The original plan entailed digging a great tunnel, emptying into the gorge just below the Falls and extending beneath the city of Niagara Falls to the beginning of the upper rapids. There, beyond the built up area of the city, room for an industrial settlement was available. Short lateral surface canals were to bring water in from the river, dropping through vertical shafts into the tunnel below, to motivate water turbines of individual mills set out along the upper part of the tunnel. As soon as work started on the tunnel, it was decided that a more practical solution would be to generate power in one central spot and transmit it to factory sites, rather than have a separate water wheel for each factory. Officials of the Niagara Falls Power Company, after seeking advice of leading scientists of America, went to Europe in 1890 to obtain the benefit of hydraulic experience and knowledge there. As a result, it was decided to build one central power plant (the Adams Station), and to generate and distribute alternating current electricity. At that time, the use of electricity for commercial purposes was in its infancy, and the practical value of alternating versus direct current was a matter of heated scientific disagreement. To pay for the initial high cost of the project, it was

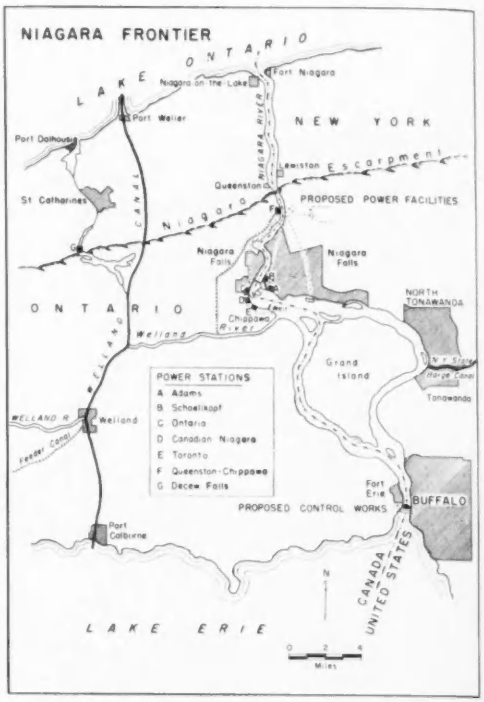


FIG. 1. The ratification of a new Canadian–United States water rights treaty has made possible the redevelopment of the Niagara Falls hydroelectric industry. (Compare with Figs. 7 and 9.)

[1] Edward D. Adams: "History of the Niagara Falls Power Company," Niagara Falls Power Company, private printing, Vol. I, 1927.

assumed that power would have to be transmitted to waiting markets at Buffalo, and because direct current could not be transmitted so far economically, alternating current was chosen. Since no existing electrical project in the world involved such great masses of water, so high a drop, or so long a transmitting distance, it was necessary for the Niagara Falls Power Company to have turbines, generators, and transmitting facilities designed, invented, and constructed for the first time with little or no precedent. So successful were these efforts that today all central power stations and transmission systems are modeled after the original Niagara Falls project (Fig. 2). Electricity was first delivered commercially in 1895, and was transmitted to Buffalo the following year. Immediately, the Schoellkopf generating station was constructed in the gorge at the end of the hydraulic canal, as were several others along the Canadian bank (Fig. 3).[2]

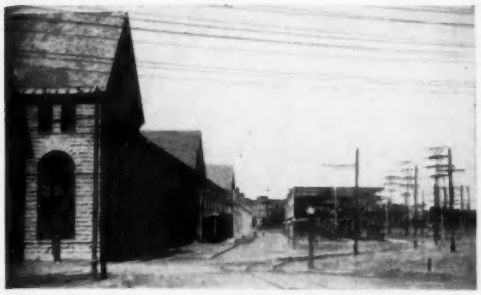


FIG. 2 (left). The Adams Station, with a capacity of 80,000 kilowatts, is the pioneer hydroelectric station. Power was first delivered in 1895 for manufacture of aluminum.

FIG. 3 (right). The Schoellkopf Station, principal New York generating plant at Niagara, is located about 1000 yards downstream from the Falls. Water from a canal and pressure tunnel drops 215 feet to power house below.

The successful outcome of the Niagara Falls experiment at generating great quantities of low-priced alternating current in a central power station was attended, coincidentally, by the invention and development of a series of manufacturing processes, the success of which depended upon huge blocks of low cost electricity. The new generators had hardly been installed when a parade of industrial establishments, such as the Aluminum Company of America, the Union Carbide and Carbon Corporation, the Carborundum Company, and others moved to Niagara Falls, initiating the great electrochemical and electrometallurgical industries of the United States (Fig. 4). So rapid was the rise of this new and unforeseen development that successive enlargements and modernization of generating facilities were unable to keep pace with demands for electricity. Although originally intended as a source of supply for Buffalo industries, Niagara Falls now supplies electricity for local industrial purposes only, receiving current for household and commercial use from steam generating facilities at Buffalo. The first exception to this was the installation, in 1947, of five new 60 cycle generators with capacity of 40,000 kilowatts.

INTERNATIONAL BOUNDARY WATER TREATIES

The rapid growth of the hydroelectric and associated industries once again alarmed the individuals and organizations concerned with preservation of scenic beauties at Niagara Falls. As a

[2] *Op. cit.*

result, a series of restrictive laws were passed, culminating in negotiation and ratification by the United States and Great Britain of the Boundary Waters Treaty of 1909–1910, which controlled the situation under direct representation by both governments prior to ratification of the present treaty in August, 1950.

Basically, the aim of the treaty was to prevent any further threat to the scenic value of the Falls by limiting water diversion to just such amounts as would not cause injury to power investments already in existence. For engineering reasons, a daily diversion of 20,000 cubic feet per second was allowed on the American side, and 36,000 cubic feet per second on the Canadian side, a total of 56,000 out of an average flow of about 210,000 cubic feet per second.[3] Because of this unequal diversion, certain amounts of electricity are exported from Canada to the United States, and several unwritten agreements have been in effect. For instance, when the Ontario Government took over control of power production, the American-owned Canadian Niagara Power Plant was left in private ownership. Canada has never interfered with or competed with transmission lines and installations owned by this company, including those serving Canadian customers.

The principal result of the 1910 Treaty was to set a rigid limit to power development capacity on both sides of the river. As market requirements grew, only expensive modernization of plants, long before equipment became obsolete, could provide additional power. Thus, on the American side at the outbreak of World War II, the more modern and more efficient Schoellkopf plant was using all water available under treaty limitations, while the older Adams plants were left idle in a stand-by condition.

After 1910 and especially since World War I, power interests on both sides of the river pointed out many times that power diversions, as determined by treaty, were much lower than necessary for preservation of scenic values, and that much water was going to waste. A whole series of plans, investigations, schemes, and even proposed treaties for complete development of Niagara power made their appearance. However, it was not until the enormous demands for power in World War II arose, followed by postwar needs and threats of World War III, that definite steps were taken to remedy the situation.

Late in February, 1950, Secretary of State Dean Acheson, and Canadian Ambassador H. Hume Wrong, signed a new treaty designed to embark the two nations on the biggest international power project in history. By June the treaty had been ratified by the Canadian House of Commons. Although opposition arose in Washington, the rapidly deteriorating international situation, plus public urging by power-hungry Canada, resulted in sudden ratification of the treaty by Senate action in August, 1951. Although this permitted Canadian plans to proceed, the Senate specifically prevented any change in United States power development until such time as Congress should determine the proper agency to carry out such redevelopment.

In the new treaty, the regulations on diversion of water for power purposes are of paramount importance. During the tourist season (April 1 to October 31), daytime flows in excess of 100,000 cubic feet per second will

[3] United States Senate Document 128, "Preservation and Improvement of the Scenic Beauty of the Niagara Falls and Rapids," Final Report of the International Board, Washington, D. C., 1931.

be available for power production. During nighttime (sunset to sunrise), all flows in excess of 50,000 cubic feet per second will be available, for scenic values are not so important then. In the non-tourist season, flows in excess of 50,000 cubic feet per second will be usable except when additional water is required for ice flushing in the gorge. Also, water for power purposes is to be shared equally by the two countries concerned.[4] This no doubt will obviate the need for unwritten agreements and eliminate the last privately-owned power plant on the Ontario side. However, if one country does not have facilities available for use of its increased share, the other country has the right to use all water made available by the new treaty. Since Canadian redevelopment is now actively underway, Ontario will have full use of all additional water above present amounts until such time as the United States Congress chooses among the United States Army Engineers, Power Authority of the State of New York, or the Niagara Mohawk Power Corporation as the redevelopment agency.

POWER SITES

Power facilities at Niagara Falls have undergone a continuing metamorphosis as constantly changing needs and improved techniques have brought about more efficient and complete utilization of the natural site. The country traversed by the river constitutes two plains separated by a steep bluff, the Niagara Escarpment (Fig. 1). The upper plain has a gently undulating surface with a general height about 600 feet above sea level. The lower plain borders Lake Ontario and is comparatively smooth. The Niagara River, natural outlet of 263,500 square miles of Great Lakes watershed, drops 326 feet in its total length of 36 miles. A mile above the Falls, the river enters upon the great upper rapids which account for about 55 feet of the descent. Niagara Falls then plunge vertically 167 feet over a crest length of 1000 feet at the American Falls, and 162 feet over a crest length of 2600 feet at the Canadian or Horseshoe Falls. Below the Falls, the river runs in a great gorge which has been carved out of the upper plain. In its course below the Falls, the river descends 99 feet more to the level of the lower plain. Altogether, the gorge is about seven miles long, with banks near the Niagara Escarpment about 300 feet high.

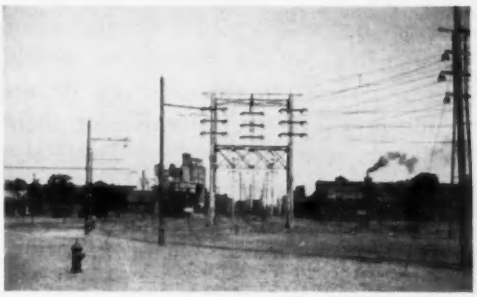


FIG. 4. Power lines carry electricity through the heart of the industrial area. Units of Carborundum Company on the left represent typical industries attracted by Niagara power.

Although recession of the Falls is a matter of widespread public interest and speculation, it does not appear that recession will affect existing power developments for a long time. Even if the present rate of retreat of about five feet per year were maintained, the intake of the Niagara Falls Power Company, situated about 6000 feet above the cataract, would not be disturbed in its present location for about 1200 years. Of more practical concern to power development is the general decrease of height of the Falls during recession as a result of the southerly dip of rock

[4] United States Senate, Executive Report 11: "The Treaty with Canada Concerning Uses of the Waters of the Niagara River," August 2, 1950.

strata. The present drop of 165 feet compares poorly with the 300 foot height of gorge walls near the escarpment. Thus the obvious point for most efficient use of Niagara Falls is not at the Falls, but at or near the escarpment.

Prior to 1870, all applications of power had been on the upper rapids with mills on the main shore or on islands in the river. Because of their low banks, the rapids above the Falls lent themselves more readily to power development by the more primitive methods then in use. After completion of the hydraulic canal, mills were built on the brink of the gorge and gradually were extended downward, utilizing a portion of the head resulting from the gorge depth. No water wheels were ever made that were capable of handling the 165 foot drop and masses of water coming over the Falls itself. It was not until the hydroelectric turbine and generator were developed in conjunction with growing market demands for electricity that the greater drop involved in the gorge and Niagara Escarpment could be fully utilized.

PRESENT POWER FACILITIES

Adams Station, pioneer hydroelectric plant, consists of two power houses containing 21 turbines, operating under a net head of only 135 feet. Turbines of the Adams Station are set in common pits about 177 feet below the surface of the ground. A short surface canal leads water from the river to the wheelpits. The force of water falling into the pits rotates the turbines which are connected by long shafts to generators up on the surface. Water then escapes from the wheelpits through the tailrace tunnel which runs for 6700 feet under the heart of the city of Niagara Falls, emptying just south of the Rainbow Bridge into the gorge. The Canadian Niagara and Toronto power plants,

FIG. 5 (left). Water from the Welland Canal plunges 280 feet over the Niagara Escarpment through steel penstocks of DeCew Falls, Ontario's oldest hydroelectric station.

FIG. 6 (right). From the Welland River, water is conveyed 8¾ miles around Niagara Falls, Ontario, in an open cut canal.

TABLE I

PRESENT OPERATING CONDITIONS OF PLANTS IN NIAGARA AREA

Plant	*Net Head*	*Installed or Rated Capacity, kilowatts*	*Maximum Water Use c.f./s.*	*KW—per c.f./s.*	*Average Daily Allotment c.f./s.*
UNITED STATES					
Schoellkopf	215	365,000	23,400	15.6	23,700
Adams	135	80,000	8,800	9.1	8,800
Totals		445,000			32,500
CANADA					
Queenston	294	373,000	17,030	21.9	15,200
Ontario	180	138,000	11,100	12.4	10,700
Toronto	137	108,000	15,500	7.0	15,000
Canadian-Niagara	135	80,000	10,600	7.6	10,600
DeCew Falls	280	149,000	7,600	19.6	3,930
		848,000			55,430

Note: c.f./s. is cubic feet per second.

located above the Falls on the Canadian shore, utilize the same principle.

Water is diverted to the Schoellkopf Station from the Niagara River above the Falls by means of a pressure tunnel and a hydraulic canal, each about 4500 feet long, having a maximum combined capacity of about 23,500 cubic feet per second. Both tunnel and canal empty into a forebay, somewhat like an open pond, located on top of the gorge. From the forebay, water is carried by penstocks to the power houses 3-A, 3-B, and 3-C at the bottom of the gorge. There falling water operates 19 turbines connected to great generators. By using the depth of the gorge, the operating head was thereby increased to 215 feet. In Canada, the Ontario plant, constructed in the gorge at the foot of the Falls, uses a similar system without the open forebay, while the DeCew Falls plant, located at the base of the Niagara Escarpment south of St. Catharines, Ontario, draws water from the Welland Canal in much the same way (Fig. 5).

Although each power plant produces great quantities of electricity, each became obsolescent almost immediately after construction because of one defect. None of these plants made use of the full head available in the distance between the beginning of the upper rapids and the Niagara Escarpment. A crude approximation, obtained by multiplying volume in cubic feet by drop in feet and dividing by ten, reveals that one cubic foot of water used above the Falls will produce about 16 horsepower. Plants at the foot of the Falls will produce about 18 horsepower, whereas those at the Niagara Escarpment, utilizing the full 300 foot drop, will generate about 32 horsepower per cubic foot of water. Therefore, the most efficient plant of all, is the Queenston-Chippawa plant (Sir Adam Beck No. 1) built by the Ontario Government a short distance south of the Niagara Escarpment.

The Queenston-Chippawa plant, completed in 1930, was the world's largest hydroelectric development for many years, and is still one of the most efficient of all such installations. Water for the plant is diverted from the Niagara River at Chippawa where the Welland River joins the Niagara (Fig. 7). By deepening and enlarging the Welland River, engineers reversed its flow for four miles. From this point, a surface canal 8¾ miles long skirts the city of

Niagara Falls, Ontario, delivering water into a forebay and screenhouse perched on the gorge wall just south of the Niagara Escarpment (Fig. 6). The ten main generating units in the gorge below have a normal operating capacity of about 525,000 horsepower (373,000 kilowatts), some of which is transmitted to Windsor and Sarnia, 240 miles away. Diverting water from above the rapids and returning it to the lower gorge, the Queenston plant is the only one making use of the maximum head between Lake Erie and Lake Ontario.

The present operating conditions of plants in the Niagara area are summarized in Table I which reveals, in column 4, the relative efficiency of the various plants.[5]

Figures in column 5 are obviously above the grand total of 55,000 cubic feet per second allowed by the original treaty of 1909–10. The increased amounts are accounted for by a series of temporary but extended agreements entered into jointly by the United States and Canadian Governments during and after World War II as a result of increased demands for power in the Niagara region.

REDEVELOPMENT IN ONTARIO

Since power corporations and interested governmental agencies in both Canada and the United States have long recognized the possibility of and need for more efficient redevelopment of Niagara power, both countries have had plans laid for some time concerning the actual construction necessary.

In Ontario, the story is relatively simple, despite the engineering problems involved. The Hydro-Electric Power Commission of Ontario has been designated as the building agency, and, of course, the project is tax supported. In addition, the Queenston-Chippawa Plant, now referred to as Sir Adam Beck Generating Station No. 1 (Fig. 9), supplies the example for most efficient use of water.

In all probability, the American owned Canadian Niagara Station will be taken over by the Hydro-Electric Power Commission and removed from service as a generating station. The Ontario and Toronto stations at the Falls will be retired to a stand-by condition so that all water available may be diverted to the escarpment end of the gorge. At certain times in winter, it will be necessary to send extra water through the gorge for ice-flushing purposes. This water will be sent through the stand-by plants which are at or above the Falls, thereby saving this water for production.[6]

The Hydro-Electric Commission lost no time, actually taking preliminary steps before the treaty of 1950 was signed. A model of the Upper Niagara River was built just outside Toronto to study the best location and design for the new station and remedial works in the river to protect scenic qualities of the Falls. In October, 1950, work began on construction of a new generating plant, Sir Adam Beck No. 2, beside the Sir Adam Beck No. 1 plant at the escarpment end of the gorge. Water is to be diverted around the Falls to the escarpment by means of a 45 foot tunnel now under construction. Starting at the head of the upper rapids, the tunnel will drop to a depth of nearly 300 feet and continue at that level under the city of Niagara Falls, Ontario. After passing beneath the existing power canal in the vicinity of the Whirlpool,

[5] Federal Power Commission: "Possibilities for Redevelopment of Niagara Falls for Power," Washington, D. C., 1949, p. 19.

[6] Private Conversations, officials of Ontario Hydroelectric Commission and Niagara Falls Power Company.

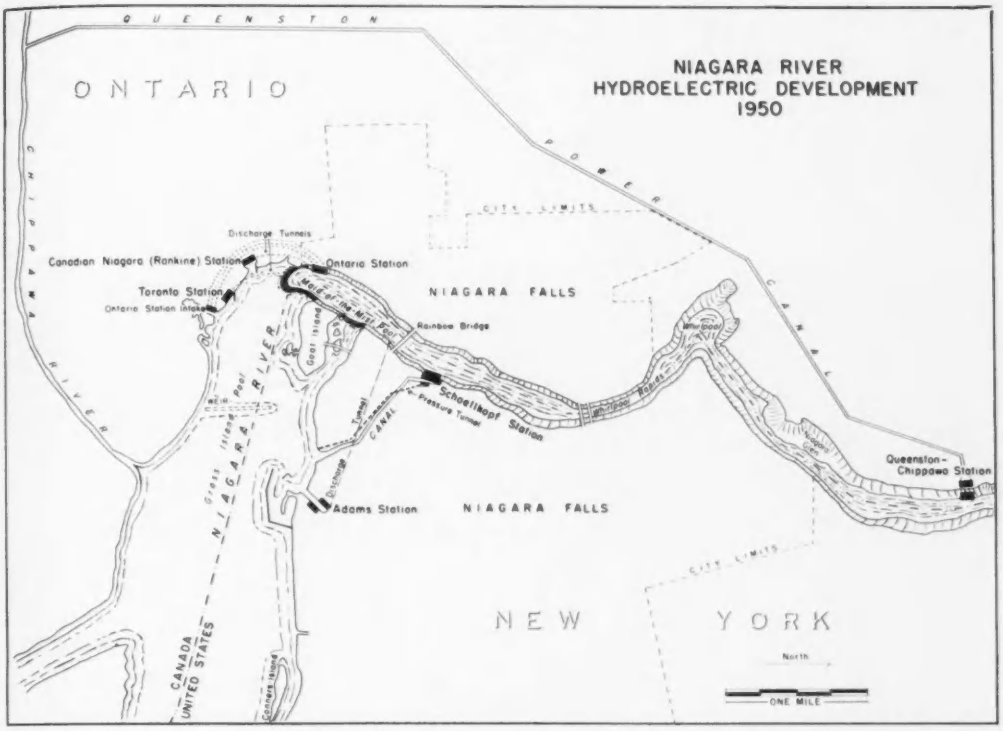


FIG. 7. In 1950, only the Queenston-Chippawa Station made full use of the available head or drop of water. The weir raised water levels to compensate for diversions above former treaty limits.

the tunnel will return to the surface. This is necessary because of the deeply buried St. David's Gorge, a prehistoric path of the Niagara River, now filled with glacial drift, which must be crossed and which fails to provide the solid rock foundation favorable for tunneling.

From that point, an open canal, with a capacity of 40,000 cubic feet per second, will convey the water to the generating station. The canal is about double the needed capacity, looking forward to the eventual construction of a second tunnel and a third generating station.

Once the water reaches the forebay and screenhouse on top of the gorge, it will then plunge through penstocks motivating six 100,000 horsepower generating units in the station at the water's edge below. The first three units are expected to be in operation by 1954, and the remaining three the following year (Fig. 8).[7]

REDEVELOPMENT IN NEW YORK

Conditions for redevelopment in the United States are somewhat more complex, for three groups, the Federal Power Commission, the Power Authority of the State of New York, and the Niagara Mohawk Power Corporation are sparring for the assignment. All, however, have agreed publicly upon the general plan for redevelopment (Fig. 9).[8]

The obsolete Adams Station is to be retired to a stand-by status. At present, the Schoellkopf plant has a capacity of about 290,000 kilowatts of 25 cycle current, supplying about 40 per cent of the 25 cycle load required by the

[7] Niagara Falls *Gazette*, September-October, 1951.

[8] Federal Power Commission, *op. cit.*

Niagara Mohawk Corporation system. This is a frequency used only by industrial establishments and cannot be economically abandoned in face of the enormous industrial investment in 25 cycle equipment. Rather than build new plants with such a non-standard frequency, it is planned to leave the Schoellkopf plant in production, and install only 60 cycle plants at the escarpment end of the gorge. Since the Schoellkopf plant fails by about 100 feet to utilize the maximum head or drop, a special intake works will pick up water coming out of its tailrace. From there, the water will be conducted by a 42 foot tunnel to a surge basin located opposite the Canadian Sir Adam Beck stations. There, a power house, containing six 20,000 kilowatt vertical generating units connected to six water-wheel turbines operating under an approximate head of 100 feet and discharging directly into the river, will be built.

The major new unit, to utilize all water except that diverted through the Schoellkopf station, will also be built near the escarpment just south of Lewiston and opposite the Sir Adam Beck plants to take full advantage of the escarpment height. Water will be diverted above the Falls in the vicinity of Connor's Island, and will be conveyed to the escarpment, some 4.8 miles, in three tunnels or two covered canals. The conduits will empty into a forebay or a surge basin on the escarpment. In the power house, twelve 90,000 kilowatt

FIG. 8. Tunnels, 24 feet in diameter, will hold penstocks leading to 100,000 horsepower units of the new Sir Adam Beck Number 2 Station. Only seven of the planned 12 units are being constructed at this time. (Photo by Harold J. Davies, Niagara Falls, New York.)

generating units and associated equipment will be installed. This is referred to as the Connor's Island-Lewiston unit.

A third and rather novel feature planned for construction on the escarpment near Lewiston is a pumped storage unit. Since demand for power varies considerably in different parts of the day, being especially low late at night, some of the allotted water cannot always be used. To prevent water from running through the plant without generating electricity, it is planned to pump unused water from the Connor's Island–Lewiston conduits into a storage reservoir. The reservoir will have a water surface area of about 850 acres and will provide storage for about 22,000 acre feet of water. Water will be diverted by two 40 foot tunnels into a suction basin, from whence a combined pumping and generating plant will pump water into the storage reservoir. When needed, water will be released back through the pump-generating station under a head of 51 to 60 feet, with a dependable capacity of 130,000 kilowatts. Re-entering the waterways at the top of the escarpment, the water will then be available a second time for use under full head through the Lewiston plant.

Under treaty terms, more water is available for power at night than in daytime, but power demand is greater during the day. In order to save allotted but unneeded night flow for use in the daytime, an additional device is planned. A control works, consisting of a gated structure, is to be built across the Niagara River a short distance downstream from the Peace Bridge between Buffalo, New York, and Fort Erie, Ontario, in addition to channel excavations in the river. With this device, water available at night when there is no need for it, will be held back and released during the day. The size of Lake Erie is such that the effect of this temporary damming will not raise the lake level enough to damage present shore installations.

REMEDIAL WORK

During World War II, a weir, or submerged dam, was constructed in the upper rapids as a joint United States–Canadian project in order to raise water levels above the Falls to compensate for emergency diversions of water above treaty limits. In addition, the weir served to spread water more evenly over the entire crestline of the Falls, slowing erosion of the Horseshoe Falls and markedly improving the scenic appearance of the entire cataract. To prevent the proposed additional withdrawal of water for power from damaging the beauty of the Falls, another extensive remedial weir is to be constructed in the upper rapids. The International United States–Canadian Joint Commission, charged with preservation of Niagara's scenic beauty, is in charge of remedial work which got underway in late 1950 with collections of soundings by helicopter. The United States Army Corps of Engineers are constructing a model of the Niagara area, about the size of a football field, at Vicksburg, Mississippi, in order to carry out research for remedial structures. A suggested plan is to construct a gated dam or compensating structure at the head of the upper rapids, in order to regulate division of flow to the two falls, maintain the river at a uniform level during the twice-a-day change in flow over the Falls, and regulate the river level to conform to the present normal seasonal cycle.

POWER PROSPECTS

It is generally estimated that redevelopment projects will cost Canada about $157,000,000 and the United States

about $350,000,000. By taking advantage of the highest head possible, it is thought that combined production of power in New York and Ontario can be increased from the present 1,300,000 kilowatts to more than 3,000,000 kilowatts. Grand Coulee Dam on the Columbia River, now the largest hydroelectric project, will have a capacity of 1,974,000 kilowatts when completed, or less than two-thirds of the capacity of Niagara plants. Dependable capacity in the United States can be increased from 440,000 kilowatts to 1,572,000

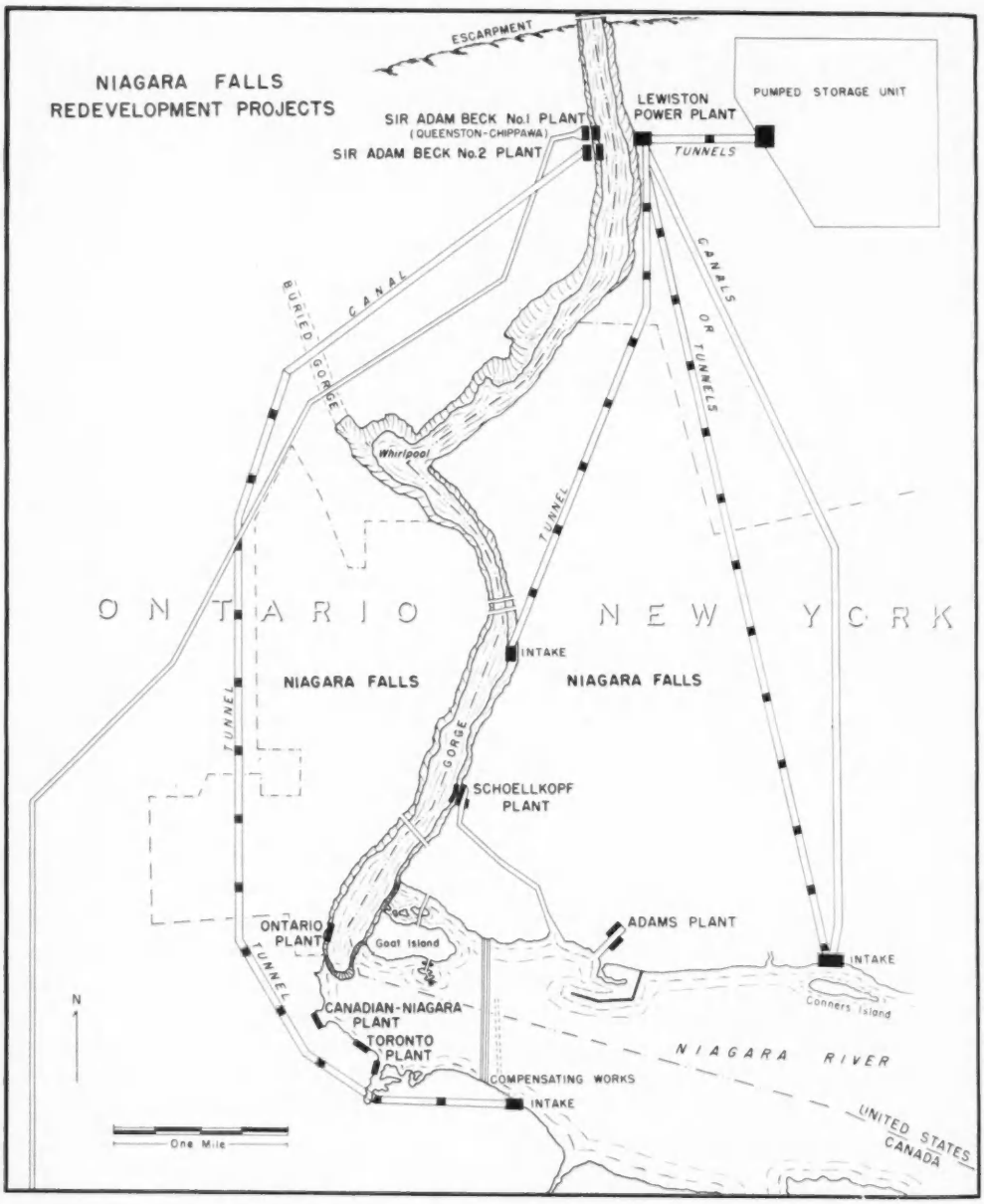


FIG. 9. Redevelopment projects are under construction in Ontario, but New York plans must await Congressional sanction. Compensating works are the joint responsibility of both countries to preserve scenic quality of the Falls.

kilowatts, with increase in energy from 3.7 billion kilowatt hours to 11.6 billion kilowatt hours.

The energetic and businesslike attack on redevelopment construction by the Ontario Hydroelectric Commission during 1951 was in stark contrast to the apparently endless stalemate on the New York side, a result of the political struggle in the United States for assignment as the redevelopment agency. Five New York private utilities, under leadership of the Niagara Mohawk Power Corporation, offered to organize and finance a company to develop power from the Niagara River. As the private utilities, the Power Authority of the State of New York, and the Federal Power Commission plus United States Army Engineers debated endlessly before Congressional Committees, the United States Government announced possible removal of essential aluminum plants from the Pacific Northwest because of acute hydroelectric power shortages. Furthermore, each day of delay significantly added one more day to the right of the Canadians to use that water destined to be utilized by the future American plants.

Nevertheless, urged on by economic, social, and political motives, man has made another great stride forward in his long effort to harness mighty Niagara, the world's great symbol of natural beauty and power.

BOOK REVIEWS

The Geography of Hunger, by JOSUÉ DE CASTRO. xiv and 337 pp.; bibliogr., index. Little, Brown & Company, Boston, 1952. $4.50. 8½ x 5½ inches.

This is a provocative book. It may prove an important book. But it is certainly not scholarly, and, in the reviewer's considered opinion, it is dangerous, for it is full of half-truths and non sequitors written with such passion that an uncritical reader may be swept away by it. It may be the nature of things that polemics are necessary for progress. It may take Vogts and Burches on the one hand the de Castros and Hansons on the other to set ideas in motion, while more cautious scholars write critical reviews or nothing at all. This reviewer has always defended the purveyors of "ultrageous theories" for such reasons, but "The Geography of Hunger" makes one wonder if there is a point at which an ultrageous theory becomes menacing.

These are harsh words, but one need only read ten pages of "The Geography of Hunger" to find material for ten pages of adverse comment. The very title of the first chapter exemplifies the recklessness of statement: "The Taboo of Hunger." De Castro holds that hunger and sex have been tabooed, but the parallel is false. The most strait-laced Victorians never concealed the fact of eating. If western scientists of recent years have neglected the subject of starvation, it could be because famine has not been an insistent problem in the lands where they earned their living, but this is no taboo. The fourteen pages of bibliography in de Castro's book show that hunger has not been neglected as much as he makes out.

Much of the book revolves around two pet theories. One of these blames "imperialism" for most of the world's hunger. De Castro writes ". . . the world's great areas of endemic hunger are exactly the colonial areas." He adds that he means economic as well as political imperialism. This qualification almost prevents a critical examination of his statement, since "economic imperialism" is used so broadly. The reviewer has no desire to whitewash the record of the imperial powers. They have plenty of sins to answer for. But de Castro overemphasizes the imperialist basis of hunger. Italy, a chronically hungry land, can hardly be called a colony. Two of the worst famines of modern times occurred in the Soviet Union.

Japan presents a problem for de Castro. Japan has never been a colony, politically or economically—unless it can be called one now—yet Japan had famines during its hermit period and has had a meager diet since. De Castro resorts to such devious explanations as this: "The sin of the Western peoples lay in letting interested imperialist groups block the just aspirations of the Japanese people for a better life, and in letting the Japanese capitalists preserve a regime of medieval semislavery in a country that was, in terms of technical development, Westernized." How much more sensible seems another of his statements about Japan: "Undoubtedly the food problem has been greatly aggravated and the benefits of increased production cancelled out by the tremendous increase in population that has taken place during the years of the Allied occupation." Such occasional lapses into lucidity make one wonder if de Castro really believes his theories.

De Castro's second theory is that population pressure is caused by poor diet. This startling statement is based upon experiments that show that the fertility of rats increases as the protein content of the diet decreases. The application of this evidence to man is supported by a table showing that the birth rates of certain nations vary inversely with the intake of animal protein. One cannot deny either set of facts or the possibility that there is some causal relationship between them. However, as de Castro himself states, the offspring of rats on a high-protein diet are more likely to survive. Therefore, there is no reason to say that a high-protein diet is alone sufficient to limit population growth. In wildlife, rapid increase in numbers is believed to follow deterioration in the quality of the feed. But such population explosions are followed by increased mortality and a return to smaller numbers. The fertility and survival of man are not so simply linked to nature. By creating cultural buffers, man appears to be able to create continuing explosion. The theory that hunger is the cause of overpopulation is further refuted by de Castro's later discussion of the Netherlands. He states that the diking of the Zuider Zee will provide food for 300,000 more people but adds that such relief will be short-lived, for the Dutch population is increasing by 100,000 a year. Since the Dutch are among the better-fed Europeans, one can only ask de Castro, "Who's the Malthusian now?"

One could fill many pages with similar criticisms. This does not mean that the reviewer doubts the existence of hunger. De Castro's initial thesis that hunger is a vitally important subject is hardly open to disagreement, but also it is hardly news. One cannot deny that de Castro's book contains many significant facts. The problem is to sift fact from fiction. One may agree that ". . . the world has at its disposal enough resources to provide an adequate diet for everybody, everywhere," yet doubt that this includes everybody who may be born in the absence of family limitation. One may be highly optimistic about the production of fats and proteins from algae and fungi yet doubt that yeaststeak on the Chinese peasant's table will be sufficient to reduce his fertility to the replacement level.

The crowded, underfed millions probably constitute the greatest threat and the finest opportunity confronting western civilization. The United States, in particular, is in desperate need of sound and practical advice on economic and political steps to meet this situation. "The Geography of Hunger" offers little in the way of such advice, beyond such generalities as "reorganizing the economic apparatus" and "an effective food policy must look to distribution as much as to production." The author never pulls his ideas together to form a program. The book may harm rather than help the hungry people of the world by offering false or incomplete explanations of their misery.

STEPHEN B. JONES

Yale University

Interregional Competition in Agriculture with Special Reference to Dairy Farming in the Lake States and New England, by RONALD L. MIGHELL and JOHN D. BLACK. xii and 320 pp.; maps, diagrs., charts, tables, index. Harvard University Press, Cambridge, 1951. $5.00. 8½ x 5½ inches.

Ronald L. Mighell, Agricultural Economist in the Bureau of Agricultural Economics of the United States Department of Agriculture, and John D. Black, Henry Lee Professorof Economics at Harvard University, collaborate in this book on the subject of interregional competition in agriculture, a subject of great interest to geographers. The authors analyze a specific problem in the competition; they present specific facts and figures. An aim, stated in the preface, is not to bandy the economic terms "interregional competition" and "comparative advantage" about, but to document them in two regions which are in competition for the eastern seaboard (and specifically the urban New England) cream market, and in occasional competition for the fresh milk market.

Chapter I starts with a definite statement; the problem is nailed down from the beginning. The chapter is entitled "The Assignment"; the opening sentence is "This is a book on interregional competition." The approach as set forth is "to develop first a body of relationships that are true for agriculture as one major part of an economy, and then at the end generalize these relationships for the whole economy in so far as it is possible on the basis of this and other related studies." The actual undertaking is confined, within the agricultural economy, to that portion of the dairy products *produced* in New England and the Lake States and *consumed* in the population centers of the northeast.

The authors devote four chapters (Theoretical Framework, Analytical Method, The Construction of Supply and Demand Schedules for Farm Products, The Geography and Trends of the Dairy Industry) to the statistical and economic background of their study. Four chapters (Production Analysis-Analytical Procedure, Production Analysis—New England Dairying, Production Analysis—Lake States Dairying, and Demand Schedules, Marketing, and Pricing) deal with the present aspects of the problem of interregional competition for the market. True to the authors' plan, a tenth chapter (Summary and Outlook) integrates the supply curves of New England and the Lake States with the demand curves; specific questions are asked—for example "if the demand for milk and cream were to rise in New England markets—due to marked gains in employment, for example—with consequent rising prices relative to other farm-product prices, how much of the new supply would come from New England farms and how much of it from the Lake States farms?" The answers and forecasts are based, not on supposition, but upon actual forecasts made in 1936 for the year 1946, and now used (after correction where needed) to help answer the above and other questions.

The first ten chapters discuss the theme of the book, and carry that theme with precision from the inception of this particular interregional competition to the outlook for the future. An eleventh chapter poses some other types of regional competition in American agriculture, as that between the Cotton Belt and California in cotton-growing, between the northeast and the Lake States in egg production, between Florida and California in oranges, between the Aroostook area of Maine and the Red River valley of Minnesota in potatoes, and others. A final chapter, entitled "Public Policy Aspects," relates interregional competition to production adjustment programs, to production planning during World War II, and to other aspects of public programming in agriculture.

The economic principle underlying interregional competition is the Principle of Comparative Advantage. Since 1930 the volume of cream reaching New England from the Lake States has increased continuously and rather

rapidly. The New England index of prices paid appears to have risen more in relation to the index prices received than has that of Wisconsin; the overall trends in the two regions appear to have changed, since 1920, to the comparative disadvantage of New England. Likewise changes in the freight rates on cream have lagged behind other price changes—a factor to the advantage of producers in the Lake States. In order to obtain the picture of interregional competition the authors have analyzed in detail five dairy areas in New England—two in Vermont, one in central Maine, and one each in eastern Massachusetts and eastern Connecticut. The three northern areas are near the outer margin of the Boston milkshed; the southern areas are close to urban receiving centers. Six dairy regions (mainly counties) are analyzed in the Lake States —two each in Michigan, Wisconsin, and Minnesota. One area in each of these states is toward the Corn Belt transitional margin, wherein other enterprises are possible; the three northern areas analyzed have little or no choice of alternative agricultural enterprises. Within each of the above eleven regions detailed study is made of equal numbers of farms (1) on good and poor land, (2) of small and large size, (3) using family labor and hired labor, (4) owners and renters, and (5) of farms operated by persons under 35, of 35 to 50 years of age, and over 50. The studies are very detailed, covering, among others, such items as cropping systems, shifts in sizes of dairy herds, rates of feeding, amounts of purchased feeds, hay and pasture production, and changes in farm technology as well as price changes.

Mighell and Black, through their thorough economic study, carried on over a period of time, have contributed greatly to the subject of interregional competition. They do it specifically with respect to a particular product, and they do it with a thoroughness, both from the standpoint of the analytical method and the checked 1936–1946 forecast, to demonstrate the facts of the competition; they do not merely say that milk or cream can be diverted to Boston from a manufactural use in the Lake States—they show how and why. They are to be congratulated on their clearly stated "long-run outlook" about the future of this particular interregional competition.

Forty-one charts and 53 tables support the study. The former are listed in the table of contents as "charts," but are called figures throughout the text. Nine only of these are maps, and the other 32 are graphs of various types. All except one of the maps are associated with the chapter on the Geography and Trends of the Dairy Industry, and all maps are from either the Bureau of Agricultural Economics or the Bureau of the Census. The graphs show production, demand, prices, and other economic factors. There are also graphs of the estimates made in 1936 for 1946; these show the estimates, and the actual conditions attained in 1946 in specific marketing areas, such as Worcester, Massachusetts.

The authors list four groups for whom the book is written, and who will use it. Among these are "those interested in location theory and economic geography." This group of geographers will profit especially from the study; the literature and the understanding of interregional competition is clearly set forth.

LOYAL DURAND, JR.

University of Tennessee

Relational Patterns of Kampala, Uganda, by EDWIN S. MUNGER. xi and 165 pp.; maps, ills., diagrs., tables, references. University of Chicago, Department of Geography, Research Paper No. 21, Chicago, 1951. $2.00. 9 x 6 inches.

African geography has so long suffered from overpainted description and unfounded generalization that this factual essay on a specific segment of the African scene as it is today deserves applause. The subject is a rapidly growing urban settlement. The title suggests that it is viewed solely as a center or focus of surrounding areas that are related to it, but the author states his aim as "an understanding of . . . Kampala through . . . its relationships with the world outside its urban area." About one-third of the book is listed in the table of contents as dealing with the urban center itself, the rest with areas that are functionally related to it. Aside from photographs, Kampala is actually allotted only a few pages apart from its function as a node of larger areas.

These areas range the gamut of political, economic, and social affairs, and reach from the immediate surroundings to a large part of Africa, and in a few matters beyond Africa. Most of the information from which they were mapped had to be gathered in the field, and the small residue available in compilations required checking in the field. The result is the first survey of its kind reported from tropical Africa. The significance of the study as a pioneer is not lessened by the fact that a number of the areas had to be adduced from so few examples that they are put forward only tentatively. For example, trade figures in some lines are based on the output of a single factory. As reduced, several of the regional maps are legible only with a reading glass, despite the author's explicit statement that "the maps, diagrams, and pictures are an integral part of the study, the text being intended to supplement them." (The reproduction of the photographs also must be rated low.)

Enthusiasm engendered in this reviewer by the analysis of Kampala's relations with larger areas is dampened by the presentation of Kam-

pala itself. Since the author gives no comprehensive view of the place, he would have been better advised to confine his treatment to naming it as the functional focus of his several regions. Indeed, nothing he says about the internal character of the town is needed for the topic covered by his title. What he does say gives the impression of unassorted and in several cases incomplete items—perhaps by-products of his stay in the place.

For instance, there are numerous photographs of Kampala streets, buildings, and people, but a reader unfamiliar with Euroafrican settlements will hardly be able to make out a pattern or a portrait of this uncommon kind of urban center. There is no street plan or regional map of the urban area. Without some such map, the material presented is deprived of a setting. The painstaking profiles of two of the business streets are further devalued by lack of a scale. The listing of land-use by names of hills fits into local practice, but the reader can get no inkling of distribution—of either the landforms or their mode of occupance. The lower-lying land is disregarded, although it includes most of the areas other than residential or institutional districts. The page labelled "history" cannot properly be dignified by that name, and the page-and-a-half of "physical setting" is equally sketchy.

Possibly the Kampala material was added in order to fill out a dissertation to the dimensions of a book. A comprehensive study of that important center would be very welcome, and would make a fitting complement to the comprehensive and eminently satisfying study of the relational patterns the author has given us.

The bibliography of some 200 titles is a contribution that deserves especial commendation. As the author points out, little of his study could be derived from printed books and papers, even though he had to comb the existing publications. The materials he canvassed make up a list refreshingly unlike the stereotyped bibliographies on Africa.

DERWENT WHITTLESEY

Harvard University

Geography of Russia, by N. T MIROV. xii and 362 pp.; maps, tables, index. John Wiley & Sons, Inc., New York, 1951. $6.50. 9 x 6 inches.

The title of this book suggests more than is included. In his preface Mirov states that "the physical aspects of Russian geography have been treated to the exclusion of the economic, *since the scarcity of available data precludes an adequate discussion of this feature*" (italics are those of the reviewer).

In preparing the book Mirov has relied upon his "own knowledge of Russia and upon several Russian textbooks on physical geography, notably *Geographical Zones of the USSR* and *Priroda USSR* [*Natural Regions of the USSR*], both by L. S. Berg, and three books entitled *Physical Geography of the USSR* by N. N. Baransky, B. F. Dobrynin, and S. P. Suslov." He has undertaken this book "hoping to interpret the geographic features of the country *perhaps more accurately than a literal translation might be able to*" (reviewer's italics). Also, "considerable thought has been given to the selection of detail . . . that would appeal to an American audience." The book "is meant to be inclusive without becoming encyclopedic, and factual without losing the interest of the reader," with "the college student primarily in mind."

The text is divided into three unequal parts. Part 1—General Picture of the Country (48 pages) consists of four chapters dealing respectively with location, geology and topography, climate, rivers and lakes. Part 2—The People (29 pages) also consists of four chapters, covering historical geography, peoples, languages, and religions. Part 3—Geographic Regions (263 pages) contains 20 chapters, each devoted to a different physical region of the U.S.S.R., patterned essentially after Berg's regionalization.

On page 4 the author declares, "These factors —cold climate, great distances, a large continuous area, and domination of the northern part of Asia—have had an important influence upon the development of the country." Regrettably, he does not explain the meaning of "development of the country" and we are left to guess whether this refers to political, economic, or social development, or all three. But one is even more disappointed, after reading the entire book, to find that the author completely refrains from discussing how these factors influenced the development of the country. There is little analysis and interpretation in the book—only a huge pile of bits of information—and practically nothing about the cultural and economic geography of the Soviet Union.

The chapter on rivers and lakes avoids consideration of navigation, irrigation, and use of water power. The flavor of the chapter on historical geography is exemplified by the following: "Occupation of Siberia by the Russians was a rather spectacular enterprise. . . . Early knowledge of Siberia by the Russians was rather grotesque . . . the whole of Siberia was crossed by the Russians in only 68 years. . . . In contrast to the occupation of Siberia, the conquest of parts of Central Asia had all the marks of a military operation" (pp. 56–57).

In the chapter on people (15 pages), 22 lines are devoted to the 110 million Russians, 11 lines to the 135,000 Kalmyks, six lines to the 80,000 Tungus, and three lines to the Ainus, whose number is not given but whose "men are notable for their ample beards" (p. 64). The author indulges in anthropological excursions about ethnic fossil groups and urges the reader to keep

in mind that the ethnic background of the Turkic-speaking people is rather complicated (p. 67).

The brief chapter on languages classifies "the approximately eighty main languages spoken within the borders of the Soviet Unions," and contains some discussion of problems in linguistics as well as comments on the difficulties faced by an American in learning the grammar and idioms of the Russian language.

The chapter on religion sketches the different churches and sects of the Christians, Moslems, Buddhists, Shamanists, and pagans, but makes no mention of the Jewish religion. Mirov asserts that "the Christian religion never penetrated very deeply into the masses of Russian people" (p. 79). As for the status of religion in the Soviet Union: After 1917 the churches were "ruthlessly prosecuted. During World War II, however, the rights . . . were restored. The Orthodox Church at present is separated from the state" (p. 79). Nothing further is stated on this subject.

As for the 20 regional chapters, each starts with a verbal description of location and boundaries of the region, followed by a systematic treatment of the climate, topography, soils and vegetation, animal life, and people.

In these chapters, the sections on vegetation and animal life are long, detailed, encyclopedic listings of species, spiced for the American reader with tidbits such as: "There are several subspecies of the snowshoe rabbit (*Lepus timidus*). In Siberia they are called ushkans" (p. 112). "In the Orel Province a breed of especially fine-crowing roosters has been developed" (p. 132). "Levant wormwood (*Artemisia cina*) [is] used in medicine as an anthelmintic. The active ingredient is santonin, an oxygen-containing sesquiterpene derivative" (p. 160). "Dry apricots, called uriuk, are a common commodity in every grocery store in the Soviet Union, from Leningrad to Vladivostok" (p. 173).

Mirov does not ignore altogether the agriculture of each region. He deals with this very briefly—a few lines or two or three short paragraphs—seemingly only because the crops raised are vegetation and therefore should be enumerated. He treats animal husbandry and fishing in the same fashion. Occasionally he overlooks "the scarcity of available data" and touches upon the mining and industrial activities of a region.

The sections on people are very brief (average 11 lines per region) and largely devoted to identification of ethnic groups. A typical treatment: "The population of Crimea is composed of Russians, Ukrainians, and many other lesser groups. The Tatar population is considerable; until lately Crimea was listed as the Crimean Tatar Autonomous Republic. At present the peninsula is listed as one of the provinces of Russia" (p. 220).

There can be no question that Mirov has expended much time and effort; he has worked earnestly and hopefully to produce a textbook which would prove superior to those already available. Regrettably, this objective has not been achieved. In the absence of an up-to-date satisfactory college textbook on the geography of the Soviet Union, the student will find a combination of the older works and translations of *Natural Regions of the USSR* by L. S. Berg, and *Economic Geography of the USSR* by Balzak, Vasyutin, and Feigin, much more instructive and interesting than *Geography of Russia*.

WILLIAM APPLEBAUM

Stop & Shop, Inc., Boston

The Production and Marketing of Flax in Texas, by JOHN A. RYAN. vii and 71 pp.; maps, charts, tables. Texas Industry Series No. 1, Bureau of Business Research, College of Business Administration, The University of Texas, Austin, 1951. 50c. 9 x 6 inches.

With the publication of this bulletin, the Bureau of Business Research of the College of Business Administration at the University of Texas initiates the new *Texas Industry Series*. Although the Foreword expresses only the modest hope that the series "will be of interest and value to the people of the state," it cannot be doubted but what the ultimate circle of readers, rather especially among economic geographers, will extend well beyond the borders of Texas alone.

Mr. Ryan, the author of the present study, is currently an instructor in marketing at the University of Texas, and as a native of the Texas flax growing area he has been able to bring a considerable volume of first-hand acquaintanceship with the district to bear on his analysis. Traditionally, if somewhat routinely, he begins his discussion with a chapter describing the history of flax and its products from the site and era of their earliest known use by man in Egypt. In Chapter Two he turns more specifically to the relatively brief development story of the crop in Texas. It is from this base line that he ultimately advances to the avowed central purposes of the study, namely, "to analyze the present status of the flax industry in Texas and to determine the reasons for the rapid development of the industry since commercial production of flaxseed began in 1938."

The remaining chapters fall largely under the three primary subject headings, growing, marketing, and processing. The flax-producing area of southern Texas is defined as composing "approximately thirty counties, ranging from Travis County on the north to Kleberg County on the south and from Frio County on the west to Brazoria County on the east. This area is roughly 240 miles from north to south and the same distance from east to west. It borders on 170 miles of coastline." In general the author's

analysis of this area and the flaxseed industry which it has only recently and rather suddenly come to support, is distinctly slanted toward an economic emphasis. The physical geographic backgrounds of the crop and the ecologic relationships of its performance are treated only somewhat superficially.

If the brevity of the discussions of these matters was necessarily dictated by limitations of space, one is inclined to wish that expansion could have been achieved through the deletion of some seemingly much more peripheral items. For example the author's purposes, at least any primarily geographic designs, seem little advanced by the descriptions of recommended farm practices with flax such as rates and depths of seeding and equipment used, or the statements concerning the organization and personnel of the Texas Flax Improvement Association.

Actually, the geographer's greatest disappointment will stem from the almost complete lack of cartographic analysis. In the 71 pages there are only three maps, one an outline of Texas showing the general extent of the flax-growing counties, and two portraying the highway and railroad networks of the area. It is to be wished that maps could have been included showing the patterns of some of the physical background elements of the district, as well as such things as specific acreage and yield distributions and the relative importance of the crop in relation to total cropland.

In spite of such geographic shortcomings, however, Mr. Ryan does provide a useful summary of an interesting new development in Texas agriculture. Both this particular publication, and the forthcoming series which it heralds, represent enrichments of the literature concerning which geographers should be aware.

JOHN C. WEAVER
University of Minnesota

Oshkosh, Wisconsin—An Economic Base Study, by JOHN W. ALEXANDER. 72 pp.; maps, charts, tables. Wisconsin Commerce Papers, Volume I, No. 3. Bureau of Business Research and Service, Madison, 1951. $1.15. 11 x 8½ inches.

Economic geographers have long been partial to agricultural areas in choosing subjects for geographic analysis. However, with the increasing concentration of population in our cities it is encouraging to see the economic geography of urban centers become more and more often the subject of scholarly research. Famous studies by Harland Bartholomew, Homer Hoyt, and Victor Roterus have blazed a promising trail for investigations of this type. John Alexander applies a number of the techniques developed by these pioneers in his book, *Oshkosh, Wisconsin, An Economic Base Study*.

Oshkosh is an urban area of some 43,000 people, located astride the Fox River at its entry into Lake Winnebago, about 80 miles northwest of Milwaukee. An analysis of the economic base of the city indicates that about two-thirds of the 16,000 man labor force produces goods and services for people outside of the city (primary base), while the other third supplies the city (secondary base). Almost 96 per cent of the manufacturing activity, half the construction business, and a third of the commercial activity fall into the "primary" classification. The city's important manufacturing concerns, mainly metal, wood, and textile factories, market their products generally in the Northeastern States. The portion of the construction and commercial activities in this class serves a trade area extending mainly in a westerly direction from Oshkosh. The other half of the construction industry, two-thirds of the sales of goods and services, and almost all public service activities supply the city itself.

Chapter II presents an analysis of the structure of the city's economy. Briefly stated, Oshkosh is a manufacturing center with about half of the labor force engaged in some activity of this type. The metal industries are the most important and are growing, while the woodworking concerns, leaders in an earlier era, and still benefiting from "rail transit rates," are now in second place. Commercially, Oshkosh leads its neighbors in per capita sales by stores in the automobile, food, eating, and drinking classifications, and trails them in the other categories.

Numerous problems plague the economy of Oshkosh. Perhaps the most significant of these is tied to the rather remote location of the city, on the extreme northwest margin of the Manufacturing Belt. Raw materials for the largest factories in the city have to be imported from the East, and the finished products returned to eastern markets. Therefore, many of the factories in Oshkosh can compete with eastern concerns only by making up increased transportation costs by a low wage scale. A good share of the industries of the city are in the hands of absentee owners. Under present zoning practices, there is little room available for new factories, and only two new factories have been built since 1940. Commerce, too, labors under a "locational" handicap. The "natural" trade area of the city, restricted to a semicircle by Lake Winnebago, includes much comparatively infertile, sparsely populated land. Then too, Oshkosh has been without a first-class paper to cultivate its trade territory. The city has limited parking facilities and an "old looking" commercial core. The low industrial wage rates are reflected in small bank deposits and a low per capita purchasing power.

Oshkosh has a sobering set of problems. To bring them out into the open in a study participated in by the local Citizens Planning Committee, and for which the Chamber of Commerce

was paying the field expenses, takes courage of the first order.

This study does a good job of uncovering the city's problems. However, it is doubtful if the conclusions offered will be of much aid in their solution. Six of the seven "courses" for action are dealt with in extremely cursory fashion in the body of the work. In fact, they seem to be items already obvious to the average civic-minded citizen and not really products of this study at all. Suggestions to increase promotional activity, merge the city's promotional agencies, encourage the local newspaper, encourage local capital to regain control of local industry, improve parking facilities in the business district, and zone an extensive tract of land near the railroad for industry would seem to fit into this category. Only one item, a suggestion to encourage industry to overcome its locational handicap by specializing in goods which have low transportation costs relative to value, stems directly from the major thesis of this study and is alone worthy of the effort of a trained economic geographer.

A professor in a state university has an obligation of service to the people of the state. This work provides an objective analysis of the economy of Oshkosh and therefore should prove of use to the citizens of the city. Minor defects, such as an occasional map without a scale or direction indicator, probably will not bother them. Such a professor also has an obligation to provide leadership in the solution of problems brought to light in a good analysis. Here the study is less effective, since its conclusions lack imagination. And is it not true that a university professor has a further obligation to his professional colleagues and the public at large to provide leadership in advancing the frontiers of his discipline? Admittedly, any geographic study of a heretofore uninvestigated area adds a missing fragment of knowledge to the total world mosaic. But the application of techniques, already well developed, to a fairly familiar area is perhaps a waste of valuable time to anyone beyond the graduate student stage. If our well trained professionals expend their energy on the multitudinous possible jobs of routine nature, who is going to do the work necessary to bring the youthful fields of economic and urban geography to respectable and fruitful maturity?

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Ten Rivers in America's Future: The Report of the President's Water Resources Policy Commission, Volume 2. xx and 801 pp.; maps. United States Government Printing Office, Washington, D. C., 1950. 10¼ x 7⅞ inches.

This volume is one of three volumes of a report which was submitted to the President by a 7-man Commission after a year's deliberation on policy problems in the field of water resources. Of the three volumes, *Ten Rivers* is perhaps of widest interest to geographers, although the other two volumes—*A Water Policy for the American People* and *Water Resources Law*—should, by no means, be overlooked by geographers interested in natural resources.

The purpose of the *Ten Rivers* volume was to provide the Commission with "practical examples of the problems for which a national water policy must furnish workable answers." Thus the studies in this volume were the grist from which the Commission derived its policy recommendations for Volume I. *Ten Rivers* consists of studies of the developmental and policy problems in the basins of the Alabama-Coosa, Central Valley of California, Colorado, Columbia, Connecticut, Missouri, Ohio, Potomac, Rio Grande, and Tennessee Rivers. The analyses were prepared by two Committees consisting of staff members of the Commission and representatives of the major Federal agencies concerned with resources and area development. The geographic profession was represented in the work by a member of the Commission, Gilbert F. White; the chairman of one of the Committees preparing the *Ten Rivers* report, Edward A. Ackerman; several members of the Commission's staff; and several of the agency representatives. Other professional persons involved in the *Ten Rivers* report included engineers, land economists, foresters, and public health officers.

The content of discussion for each of the river basins follows a general pattern: a general description of the Basin's people, economy and problems, a description of the physical characteristics of the river, a discussion of the opportunities for resource development and the existing resource programs, an analysis of the problems confronting public policy in the resource field, and finally the framework of a future plan for the full development of the basin's resources.

Perhaps the two most significant contributions of *Ten Rivers* are (1) that it pulls together information on the various resource projects and programs operating in each basin into a convenient, authoritative reference catalog—a necessary first step for any type of planning and policy consideration; and (2) that it identifies, defines, and throws light on the tremendously important problems of public policy with respect to resource development which take on unusual reality and interest because they are discussed in the environment in which they actually occur.

Among the problems of policy singled out for discussion are the conflict between constructing dams for navigation, irrigation, and power purposes and sustaining future fishery production in the Columbia Basin; the desirability of acreage limitation laws in irrigation development in the Central Valley of California; com-

peting demands—such as between industry and irrigation—for limited supplies of water in the Missouri Basin; the practicability of flood plain zoning in the Rio Grande; various devices for making further irrigation development appear less like compounded subsidy in the Colorado; the conflicts between upstream and downstream interests in the Connecticut; the relation of water resources to the readjustment of the regional economy in the Alabama-Coosa; conflicts between water developments and park and recreational uses in the Potomac; the problems and implications of reservoir inundation adjustments in the Ohio; and the conflict between functional Federal administration such as agriculture and multi-purpose regional authority in the Tennessee Valley. Many of these problems and others recur from basin to basin and all demand more searching inquiry and consideration than was possible in *Ten Rivers*. Nevertheless, the Commission and its staff deserve commendation for clearly setting forth many of the issues whose solution one way or another determines who pays for resource development and who benefits and whether or not maximum use and satisfaction is made of our resources.

Ten Rivers offers at once a challenge to, and an opportunity for, geographic research in the broad field of water, resource, and regional development. The challenge calls for purposeful research to throw light on problems of great current and ultimate significance to our society. The opportunity is afforded in that the volume enables a researcher to determine quickly the problem or phase of one to which he is interested in making a contribution. The research efforts which are in demand in this field are not those of unoriented and purposeless description, but considered contributions whose findings must be reckoned with in devising solutions and programs.

Ten Rivers is a significant contribution to the unending effort to make the best use of our resources. No one with any pretense of sophistication in the resource field should fail to study it and use it as a reference work. It is to be hoped that geographic researchers will use it as a provocative take-off to further meaningful work in this important field.

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The American Oxford Atlas. Edited by BRIGADIER SIR CLINTON LEWIS, O.B.E., and COLONEL J. D. CAMPBELL, D.S.O., with the assistance of D. P. BICKMORE and K. F. COOK. 120 pages of colored maps; 98-page Gazetteer. Oxford University Press, New York, 1951. $6.50. 15½ x 10½ inches.

This atlas, although primarily designed for use by American students and teachers, gives adequate map coverage for all sections of the world. Its chief features are large groups of physical-political and distribution maps and an excellent gazetteer.

Of the 118 maps in the atlas, 87 are of the physical-political type. About one-third of these are devoted to the Americas and are grouped together in a section of the book with special page numbers and black thumb tabs to help the reader readily locate them.

All of the physical-political maps are attractively colored in soft, pastel shades ranging from greens for the lower elevations through yellows and browns for the intermediate and finally to purple and white for the highest. Two facts should be noted about this color scheme. First, the colors themselves are not always in accord with those of the International Map system which is regarded as standard. Second, uniform layer intervals have not been adopted for any of the colors, but, instead, for each sequence of maps, layer intervals have been selected which will show up the major physical features of a continent or a country to the best possible advantage.

While these changes in color and color values are innovations in this type of map, probably the most radical departure from conventional layer coloring comes in the omission of the contour lines as layer boundaries. By allowing the junction of the layers to serve in their stead, there is achieved a smooth gradation and blending of the colors into a scheme which simulates molded relief.

In addition to the attractive colors, two other factors add to the beauty of this group of maps. These are clear-cut conventional signs in different colors which make it easy to tell whether a line is a road, river, or railroad, and an excellent balance between the number of place names and the scale of the map.

The distribution maps number 24. Eleven of these deal with the world as a whole and cover such topics as climate, population, geologic structure, and vegetation. Population and structure are also shown in more detail for Europe and for the United States and southern Canada, while interesting land use maps have been included for these areas as well as for Monsoon Asia. Another map in this group, Canada: Economic Development (Plates XVIII–XIX), is the only one of its type appearing in the atlas, a fact which will surely be regretted by many geographers.

More conventional color schemes than those of the physical-political maps predominate throughout the series of distribution maps, but they are equally attractive. Particularly pleasing to the eye are the colors used on the World Vegetation Map (Plates VIII–IX) and the three land use maps (Plates XVI–XVII, XXIII, and XXIV).

Descriptive notes on all of the distribution maps are found on pages XXV–XXVI. These

notes together with the references cited should give the reader some idea of the tremendous amount of research involved in the compilation of this atlas.

The gazetteer, containing 96 pages of names which occur on the maps, is a very complete index of place locations. These are easily found by letter and number references to grid sections formed by the lines of latitude and longitude.

Besides its function as an index, the gazetteer includes for each country a small panel giving area, population, and administrative units, together with a list of cities with populations of over 100,000. By making such statistical material readily available, the value of this atlas as a reference work for students and teachers has been greatly increased.

The projections used in this atlas have been carefully chosen with size and shape of the area to be covered in mind and, to a lesser extent, the use to which the map is to be put.

For the physical-political maps, two types of these frameworks are used—orthomorphic, for the larger scales (1/1 M to 1/10 M), and zenithal for the smaller (1/16 M or smaller). The orthomorphic projections, whose chief virtue is freedom from local distortions in shape, are also of two types—Transverse Mercator, for areas with great north-south extent (Scandinavia Plates 46–47), and Conical Orthomorphic, for those areas whose greatest extent is east and west. This latter projection, which is the one that appears most frequently in the atlas, is widely used for sectional maps of the United States, Europe, and Asia.

The zenithal projections, which have less scale distortion than the orthomorphic types for the smaller scale maps, likewise fall into two groups, the equidistant and the equal area. The former is used for the continents of North America, Europe, Asia, and Australia, and the latter for Eurasia and sections of Africa. For the world climatic maps, Gall's Stereographic projection, somewhat modified in the higher latitudes, is a good choice, since its straight-line parallels facilitate comparative latitude studies. For other distribution maps of the world a special "Oxford" projection of the equal area type has been devised; for the smaller area maps in this group various conic projections prevail.

The virtues and faults of all these projections are discussed in considerable detail on pages 6 and 7 of the atlas, and on all maps, with the exception of Plate XVIII–XIX, Canada: Economic Development, the name of the projection used is shown. This omission is evidently an oversight which can easily be corrected in later editions.

Scales are shown on the major maps by the representative fraction and the measuring stick methods, the latter being graduated in both miles and kilometers. An excellent feature of these scales is their arrangement in various series of maps as simple multiples of each other thus facilitating comparisons of areas and distances. Series having such scale arrangements include the 1/2½ M and the 1/5 M of the United States, 1/16 M and 1/32 M for the Americas, and the 1/4 M, 1/8 M, and 1/16 M of Africa. While most of the maps are on adequate scales, the World Physical (Plate A-1, Scale 1/100 M) and the World Political Hemispheres (Plates 17, Scale 1/90 M) are too small to be effective. Their scales should be enlarged in future editions.

Three other scale matters are worthy of consideration for any revised edition. The most important of these has to do with the scales of the inset maps since no consistent policy concerning them seems to have been followed. For example, on plates A-6 to A-7 representative fraction and measuring stick scales are shown for all five insets; on plates A-8 to A-9 the scale of the inset is indicated as the same as that of the main map; whereas on plates 46–47 there are no scales of any sort for the two insets. Such a situation leads to confusion and doubt in the mind of the reader, especially if the insets are of regions distant from the area of the main map, as in the case of Iceland and the Faeroe Islands on the map of Scandinavia (Plates 46–47). To relieve this situation each inset should have a scale of its own.

The second scale criticism concerns the small figures which occur in both the right and left hand margins of most of the maps; the former showing the area in square miles of each quadrilateral formed by the map grill, and the latter, the distance in miles along each parallel of latitude between two successive meridians. These are extremely difficult to read and are of little value to the average student. If retained, they certainly should be made more readable.

The third point regarding scale is a minor one, having to do with the omission of the explanatory words and figures on the scale bar of the Newfoundland inset (Plate A-5). In a revision these can be easily added.

In doing the research for the maps, in their compilation and drafting, and in their engraving and printing, editors, cartographers, and craftsmen have cooperated with the idea of producing an atlas which is pleasing to the eye and has a minimum of error. Thus it comes about that the American Oxford Atlas, which is the product of scholarly research and expert craftsmanship, represents an outstanding milestone in modern English cartography.

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